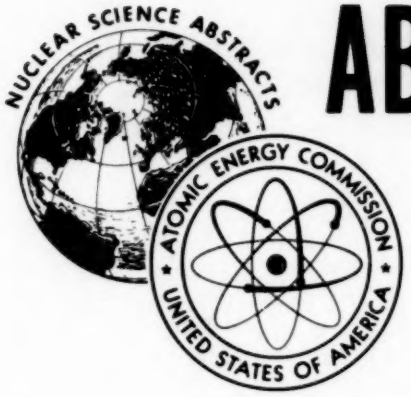
NUCLEAR SCIENCE ABSTRACTS



Volume 29 Number 6

Abstracts 12494-15204

March 31, 1974

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NOTICE

A title page for Volume 29, Numbers 1–6, is included at the back of this issue for use in binding those issues.

CORRECTIONS

NSA Vol. 28, No. 8, Abst. 19150 should be replaced with:

The stored beams in SPEAR are studied with several synchrotron-light instruments: 1. The beam profiles are observed with television cameras. 2. The vertical and radial intensity distributions of the beams are scanned at 100 Hz with oscillating mirrors. 3. The bunch length is measured with a resolution of 350 ps by vacuum photodiodes. 4. The beam currents are measured photometrically. The problems of bringing the visible light out of a high-powered storage ring are discussed. (auth)

Volume 29, Number 6, March 31, 1974

NUCLEAR SCIENCE ABSTRACTS

A semimonthly publication of the USAEC Office of Information Services, John A. Harris, Director.
Published by the USAEC Technical Information Center, Robert L. Shannon, Manager.

Nuclear Science Abstracts provides the only comprehensive abstracting and indexing coverage of the international nuclear science literature. It covers scientific and technical reports of the U. S. Atomic Energy Commission and its contractors, other U. S. Government agencies, other governments, universities, and industrial and research organizations. In addition, books, conference proceedings, individual conference papers, patents, and journal literature on a worldwide basis are abstracted and indexed. Each issue of *Nuclear Science Abstracts* includes four indexes: subject, personal author, corporate author, and report number.

The following organizations scan and abstract the nuclear science literature in their respective countries for input to the International Nuclear Information System of the International Atomic Energy Agency. By special agreement, the input to INIS is simultaneously sent to the USAEC Technical Information Center to enhance the timeliness of coverage of that literature in *Nuclear Science Abstracts*.

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Numerous organizations, societies, and publishers throughout the world provide *Nuclear Science Abstracts* with advance page-proof copy of their publications.

A list of the journals scanned regularly and the abbreviations used appears in the January 15 issue of *Nuclear Science Abstracts* and is supplemented in the July 15 issue. The January 15 issue also describes the scope and arrangement of the subject matter covered in *Nuclear Science Abstracts*. The subject matter covered is also described in TID-4552, *Subject Scope of Nuclear Science Abstracts*, available free from the USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830. An outline of the subject categories appears in the Contents of each issue.

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Personal Authors

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

COX, S.H, DNA replication of induced prophage in Haemophilus influenzae, 28:18453
CRANDALL, J.L, Californium-252 neutron sources, 28:18415 (DP-MS-72-45)
CRAWFORD, J.F, Electron multiplication in cavities, 28:18990

Subjects

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

Examples:

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Institute of Nuclear Research two-year-book, 1970--1971, 28:19902 (INR--1410)
RED DWARF STARS/STAR EVOLUTION
Perturbing aspects of the companions of Barnard's star, 28:19287
REFRACTORIES/ELECTRON MICROSCOPY
Electron microscope for investigation of metals at high temperature, 28:18834

Corporates

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

19981 (ORNL-4804) ^{238}U NEUTRON ELASTIC-SCATTERING CROSS SECTIONS FROM 6.44 TO 8.56 MeV. Kinney, W. E.; Perey, F. G. **(Oak Ridge National Lab., Tenn.).** Jun 1973. Contract W-7405-eng-26. 17p. Dep. NTIS $4.00.

is indexed as:

OAK RIDGE NATIONAL LAB., TENN.
^{238}U neutron elastic-scattering cross sections from 6.44 to 8.56 MeV, 28:19981 (ORNL-4804)
Analytical techniques for determining levels and fates of trace elements in a fossil-fueled steam plant, 28:17850 (CONF-730817-1)

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Public availability of all U. S. Atomic Energy Commission reports is indicated in the report number indexes. The availability of other reports, when known, is also indicated. The availability of some unnumbered reports is given in the abstract.

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Information on the availability of the published literature and unpublished conference papers abstracted in *Nuclear Science Abstracts* can be obtained from the USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

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Volume 29, Number 6 March 31, 1974

NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical and Separations Chemistry

Refer also to abstracts 12820, 13068, 13146, 13243, 13244, 13246, 13260–13266, 13677, 14233, and 15063.

Activation and Nuclear Reaction Procedures

Refer also to abstracts 12678 and 12806.

12494 (CEA-CONF-2404) EXAMPLES OF THE APPLICATION OF ACTIVATION ANALYSIS TO THE ANALYSIS OF ART OBJECTS. Diebolt, J. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. des Radioelements). May 1973. 14p. (In French). (CONF-730575-3). Dep. NTIS (U. S. Sales Only) $3.00.

From international conference on application of nuclear data in the field of work of art; Rome–Venice, Italy (24 May 1973).

The application of neutron activation analysis to the study of old papers, ceramics, and picture pigments is described. Examples of the use of activation analysis of each of these types of objects are given. (JSR)

12495 (COO-535-693, pp 53-56) TRACE AMOUNTS OF FLUORINE DETERMINED BY THE $^{19}F(p,p'\gamma)$ REACTION. Rudolph, H.; Kraushaar, J. J.; Ristinen, R. A.; Meglen, R. R. 1 Nov 1973.

In Nuclear Physics Laboratory technical progress report, November 1, 1972–November 1, 1973.

12496 ISOTOPIC CARBON ANALYSIS USING LOW ENERGY PROTONS. Close, D. A.; Malanify, J. J.; Umbarger, C. J. (Los Alamos Scientific Lab., NM). Nucl. Instrum. Methods; 113: No. 4, 561-571(1973).

An investigation of the $^{12}C(p,\gamma)^{13}N$ and $^{13}C(p,\gamma)^{14}N$ reactions has been made to determine their applicability for assaying materials for their ^{13}C enrichment. The system was calibrated by measuring the ratio of the yield from the $^{12}C(p,\gamma)^{13}N$ reaction to the yield from the $^{13}C(p,\gamma)^{14}N$ reaction as a function of the ^{13}C enrichment for potassium acetate targets having known ^{13}C enrichments. Using the experimentally determined calibration curve, many different materials have been assayed. Measurements were made using both a high resolution Ge(Li) detector and a NaI detector. Several proton beam energies were used to determine the optimum energy for assay measurements. The radiative capture technique for determining ^{13}C enrichment is compared with the more classical techniques for the analysis of ^{13}C tracer experiments. (auth)

12497 ACTIVATION ANALYSIS WITH SHORT-LIVED NUCLIDES AND ISOMERS. Grass, F. (Oesterreichische Hochschule, Vienna). Nucl. Instrum. Methods; 114: No. 1, 49-60 (1974). (In German).

Activation analyses using short-lived isotopes, e.g., the 20 ms nuclides or isomers ^{12}B or $^{24}Na^{m}$, are described. These nuclides stand for many longer-lived nuclides with half-lives of less than 1 s. The advantages of using short-lived nuclides for activation analysis especially in combination with reactor impulse are outlined. The maximum increase of sensitivity in relation to the half-life is shown graphically. The practical application of AA with 20 ms nuclides is demonstrated on the simultaneous analysis of sodium and boron in Jenaer G 20 glass. In five determinations the mean errors of the average were 2.5 and 3.5% for sodium and boron respectively. As the two simultaneous measurements require only 400 ms, this method is very useful for serial analyses, particularly if a computer in on-line operation is available. (auth)

12498 ACTIVATION ANALYSIS STUDIES WITH FAST NEUTRONS OF THE OXYGEN CONTENTS OF VARIOUS POLYETHYLENE PLASTICS. Zietlow, K.; Nagorny, K. (Univ., Hamburg). Kerntechnik; 15: No. 10, 473-475(Oct 1973). (In German).

In activation analysis measurements of low oxygen concentrations it is important to keep to a minimum the factors determining the background level, in particular the oxygen content of the sample transport containers and that of the surrounding atmosphere. In order to determine the operating conditions necessary for this purpose, first, the entire activation was carried out in a nitrogen atmosphere and, second, several low-pressure and high-pressure polyethylenes, which can be used for making sample transport containers, were investigated with respect to their oxygen contents. Then studies were carried out with a nickel transport container. It was found that, after thorough cleaning, this container causes the lowest oxygen background. (GE)

12499 SIMULTANEOUS DETERMINATION OF MERCURY, BROMINE, ARSENIC, AND CADMIUM IN BIOLOGICAL MATERIALS BY NEUTRON ACTIVATION ANALYSIS. Lee, C. L.; Kim, N. B.; Park, E. B. (Korea Atomic Energy Research Inst., Seoul). J. Korean Nucl. Soc.; 5: No. 4, 279-285(Dec 1973).

A method for the simultaneous determination of mercury, bromine, arsenic, and cadmium in biological samples is described. Following neutron activation and a simple distillation of volatile compounds, mercury and bromine were determined by gamma spectrometry. Arsenic and cadmium were further separated by cation exchange separation and determined similarly. Determination limits for mercury, bromine, arsenic, and cadmium were 0.001 μg, 0.003 μg, 0.001 μg, and 0.02 μg, respectively. The method was applied to the determination of mercury, bromine, arsenic, and cadmium in rice and fish samples. Analysis of a standard kale powder yielded the values of 0.046 μg/g for mercury, 24.5 μg/g for bromine, 0.17 μg/g for arsenic, and 0.50 μg/g for cadmium. (auth)

Chemical and Spectral Procedures

Refer also to abstracts 12750, 12966, 13075, 13105, 15117, and 15189.

12500 (BARC–690, pp 25-30) CHEMICAL ANALYSIS OF PLUTONIUM. 1973.

Research is reported on the determination of plutonium in PuO_2 samples from the Fuel Reprocessing Division by potentiometric titration. Areas studied include dissolution of sintered PuO_2; estimation of Pu in UO_2–PuO_2 mixtures, Pu–Al alloy, and Pu–Ga alloy; and accuracy of the potentiometric method of estimating plutonium. (DHM)

12501 (BARC–690, pp 30-33) MASS SPECTROMETRY. Jain, H. C.; Chitambar, S. A.; Kavimandan, V. D.; Periaswamy, G.; Shah, P. M.; Ramasubramanian, P. A.; Mathews, C. K.; Ramaniah, M. V. 1973.

Research progress is reported in the following areas: calibration of the mass spectrometer (determination of overall mass discrimination factor); IDA-72 experiment conducted by IAEA and Kernforschungszentrum (mass spectrometric analysis of the dissolver solution from a reprocessing plant for concentration and isotopic composition of U and Pu with purpose of evaluation precision and accuracy and to find any effects of ageing and transport on analytical results); and isotope dilution method for the estimation of total plutonium in the input accountability tank in a reprocessing plant. (DHM)

12502 (BARC-690, pp 33-42) SPECTROGRAPHIC ANALYSES. 1973.

Research is reported in the following areas: estimation of metallic impurities in plutonium; spectrographic estimation of Li, Be, Ce, and Th in high purity bismuth metal; spectrographic estimation of some common impurities in high purity arsenic; and spectrographic estimation of some common impurities in high purity sulfur. (DHM)

12503 (BARC-690, pp 62-68) O/M RATIO OF ACTINIDE OXIDES. Sampath, S.; Chawla, K. L.; Chackraburtty, D. M. 1973.

Thermal and chemical methods for determining O/M ratios of actinide oxides were investigated. (DHM)

12504 (CEA-CONF-2406) APPLICATION OF SPARK MASS SPECTROMETRY TO THE STUDY OF A PROBLEM OF COMPOSITION AND SOURCE OF ARCHAEOLOGICAL CERAMICS. Stefani, R.; Berthod, J.; Pellet, J.; Bourguillot, R.; Cornu, A.; Bouchez, R. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). 1973. 16p. (In French). (CONF-730575-7). Dep. NTIS (U. S. Sales Only) $3.00.

From international conference on application of nuclear data in the field of work of art; Rome-Venice, Italy (24 May 1973).

Spark source mass spectrometry has been used to compare the atomic compositions of red and grey sherds of the same site. A specific operating procedure allows one to determine thirty trace elements and to analyze semiquantitatively major and minor elements, in one experiment with a 200-mg sample. Comparative geological samples are used for accurate measurements. From the results, there is no systematic difference between the atomic compositions of these two types of sherds. (auth)

12505 (MLM-2022) ELECTRON SPECTROSCOPY FOR CHEMICAL ANALYSIS (ESCA). Black, J. N. (Mound Lab., Miamisburg, Ohio (USA)). 3 Jan 1974. Contract AT-33-1-GEN-53. 58p. Dep. NTIS $5.45.

In addition to the 452 references in this bibliography on electron spectroscopy, there are keyword and author indexes. (LK)

12506 ANALYTICAL CHEMISTRY OF URANIUM(III). Determination of Uranium(III) by the Absorbance in the uv-Region of the Spectrum. Nemodruk, A. A.; Myasoedov, B. F.; Koiro, O. E. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim.; 28: No. 10, 1970-1973(Oct 1973). (In Russian).

The absorption of light by hydrochloric solutions of uranium (III) has been studied as a function of HCl concentration. Two intensive absorption maxima at 348 nm ($\epsilon = 1682 \pm 30$) and 319 nm ($\epsilon = 1610 \pm 30$) have been observed. The optical density of uranium (III) solutions does not depend on HCl concentration within 0.1 and 3 M. A method is suggested for determining uranium (III) in solutions by its absorption at 348 nm. Uranium (IV), alkali and alkaline earth elements as well as Mg, Al, Zr, Th and La do not interfere. (auth)

12507 DETERMINATION OF MAGNESIUM, CALCIUM, AND STRONTIUM BY ATOMIC-ABSORPTION SPECTROPHOTOMETRY. K'o Hsueh T'ung Pao; 18: No. 4, 174-178(Oct 1973). (In Chinese).

Atomic-absorption spectrophotometry has been applied to the determination of magnesium, calcium, and strontium. The work was carried out with a Unicam SP 90 atomic-absorption spectrophotometer with air-acetylene flame accessories. The slit width was 0.1 mm and the burner length was 10 cm. The acetylene flow rate was 1.5 liters per minute and the oxidant flow rate was 4.5 liters per minute. Chemical inter-element interferences and ionization interferences were investigated. Conditions for interference-free operation for the determination of Mg, Ca, and Sr in saline were discussed. In more complicated situations, the addition of a deionizer and a releasing agent may become necessary. (auth)

12508 KINETICS OF GAS-METAL INTERACTION APPLIED TO DETERMINATION OF GASES IN METALS BY THE METHODS OF VACUUM FUSING AND ISOTOPE DILUTION. II. Kinetics of Gas Evolution in the Determination of Oxygen and Carbon in Metals by the Methods of Oxidation and Reduction Fusing. Vitol, E. N.; Orlova, K. B. (Central Scientific-Research Inst. of Metallurgy and Welding, Leningrad). Zh. Anal. Khim.; 28: No. 9, 1792-1800(Sep 1973). (In Russian).

A three-step mechanism of gas evolution from the Fe-Me-C-O melt is suggested and mathematically described. The diffusion mass transfer of oxygen in the surface layer of the liquid metal is a driving step under conditions of reduction fusing (at an excess of carbon). The rate of removing carbon is limited by the desorption of carbon oxide under conditions of oxidation fusing (at an excess of oxygen). (auth)

12509 POTENTIOMETRIC STUDY OF URANYL COMPLEXES OF O-HYDROXYACETOPHENONE OXIME AND ITS SUBSTITUTED DERIVATIVES. Ingle, D. B.; Khanolkar, D. D. (Marathwada Univ., Aurangabad, India). J. Indian Chem. Soc.; 50: No. 2, 103-105(Feb 1973).

The metal-ligand stability constants of uranyl ions with substituted o-hydroxyacetophenone oximes were determined by the Bjerrum-Calvin pH titration technique. An aqueous dioxane medium containing 75% dioxane by volume and 0.1 M $NaClO_4$ was used. The linear relations between metal-ligand stability constants and proton-ligand stability constants were examined. (INIS)

12510 SUBSTOICHIOMETRIC COULOMETRIC METHOD FOR DETERMINATION OF Se, Te, Ag, AND Cu. Khamrakulov, T. K.; Agasyan, P. K ; Petaeva, T. I. (Samarkand State Univ., USSR). Zh. Anal. Khim.; 28: No. 9, 1759-1762(Sep 1973). (In Russian).

The electrochemical behavior of tellurium in aqueous and nonaqueous media was studied and optimal conditions for its determination were found by the substoichiometric coulometric method. The method suggested has been tested on model solutions of Te(IV), Te(IV)-Ag(I), Te(IV)-Cu(II), Te(IV)-Se(IV) prepared by dissolving pure (99.99%) metals. The analysis results are precise. The duration of a determination is 5-10 min. (auth)

12511 USE OF PHOSPHOTUNGSTENOMOLYBDENUM COMPLEXES FOR PHOTOMETRIC DETERMINATION OF MOLYBDENUM AND TUNGSTEN IN THE PRESENCE OF EACH OTHER. Mal'tseva, G. V.; Reznik, B. E. (Dnepropetrovsk State Univ., USSR). Zh. Anal. Khim.; 28: No. 9, 1751-1753(Sep 1973). (In Russian).

Optimal conditions have been found for the reduction of a phosphotungstenomolybdenum complex by ascorbic acid in an acidic medium. $\lambda_{max} = 825$ nm at the ratio of P : W of between 1 : 1 and 1 : 2.5 and in the presence of an excess of molybdenum. The complex can be used for determining tungsten without its masking or separation of molybdenum. Beer's law is obeyed for the tungsten concentration of within 0.5 and 5 μg in 50 ml. A procedure is suggested for the analysis of binary molybdotungsten alloys by the differential photometric method from a single sample. (auth)

12512 SPECTROSCOPIC STUDIES OF THORIUM OXALATE COMPOUNDS. Kharitonov, Yu. Ya.; Balakaeva, T. A.; Molodkin, A. K. (Inst. of General and Inorganic Chemistry, Moscow). Zh. Neorg. Khim.; 18: No. 10, 2869-2871(1973). (In Russian).

The infrared absorption spectra (400-4000 cm^{-1}) were studied for various thorium oxalate compounds. Reference is made to some group characteristic frequencies. It was shown that in all compounds studied, the state of the oxalate group was the same as in complexes with bidentate oxalate groups. The thorium-oxygen bond of the oxalate group is apparently covalent. (tr-auth)

12513 DETERMINATION OF IMPURITIES IN HIGH PURITY TELLURIUM. VI. Determination of Zinc by Dithizone Method Using Toluene. Wilczewski, T. (Inst. of Chemistry and Inorganic Tech., Danzig). Chem. Anal. (Warsaw); 18: No. 4, 897-900(1973). (In Polish).

A lengthy procedure for determining zinc in tellurium, by the dithizone method using toluene, is described. In a 10-g sample of 99.999% pure tellurium, 0.26 μg of zinc was determined, corresponding to $2.6 \pm 1.0 \times 10^{-4}$% zinc present. (TTT)

12514 RECENT DEVELOPMENTS IN METHODS FOR THE DETERMINATION OF ANIONS. Boltz, D. F. (Wayne State Univ., Detroit). CRC Crit. Rev. Anal. Chem.; 3: No. 2, 147-199(Mar 1973).

The most significant recent developments in methods for the determination of anions including iodides have involved (1) the use of ion-selective electrodes in direct potentiometric measurements and potentiometric titrations, (2) the application of indirect and chemical amplification techniques in atomic absorption spectrometry, spectrophotometry, and spectrofluorometry, and (3) the utilization of extractable ion-association complexes, (4) the development of kinetic methods and associated instrumentation, and (5) the application of the combination of derivatization and gas chromatography. (auth)

Radiometric and Radiochemical Procedures

Refer also to abstracts 12713, 12726, 12770, 12778, 12813, 12819, 12968, 12975, 12995, 13030, 13044, 13046, 13047, and 13049.

12515 (ANL-8060(Pt. 2), pp 197-205) FURTHER STUDIES ON THE DETERMINATION OF ^{228}Th BY THE DEEMANATION OF ^{220}Rn. Kuchta, D. R.; Beskid, N. J.; Rundo, J. 1973.

Radiological and Environmental Research Division annual report, July 1972-June 1973.

New alpha-scintillation counters with almost 4π counting geometry have backgrounds of about 0.02 count/min. The results of measurements of the activity due to ^{212}Pb and ^{212}Bi collected on a phosphor-coated disc of Mylar are analyzed by a computer method of least squares. In routine use, the deemanation for 1400 min, followed by counting for 1400 min, permits the measurement of a few tens of fCi of ^{228}Th in solution. (auth)

12516 (BARC-690, pp 22-24) X-RAY FLUORESCENCE ANALYSIS. Jayadevan, N. C.; Chawla, K. L.; Sindh Mudher, K. D.; Chackraburtty, D. M. 1973.

Research is reported on the use of x-ray fluorescence for determining plutonium in solution and for determining individual rare earths in mixtures. (DHM)

12517 (BARC-690, pp 43-47) ESTIMATION OF FISSILE MATERIALS BY FISSION TRACK REGISTRATION IN LEXAN IMMERSED IN SOLUTIONS OF FISSILE MATERIALS. Sampathkumar, R.; Chaudhuri, N. K.; Iyer, R. H. 1973.

12518 (BARC-690, pp 48-49) NONDESTRUCTIVE ASSAY OF PLUTONIUM. Prakash, S.; Manohar, S. B.; Dange, S. P.; Ramaswami, A. 1973.

Research progress is reported on the development of γ spectrometric method for determining ^{239}Pu, ^{240}Pu, ^{241}Pu, and ^{241}Am. (DHM)

12519 (COO-535-693, pp 59-66) X-RAY FLUORESCENCE ANALYSIS. Rudolph, H.; Smythe, W. R.; Boyd, J.; Ristinen, R. A. 1 Nov 1973.

In Nuclear Physics Laboratory technical progress report, November 1, 1972-November 1, 1973.

12520 (INIS-mf-911, pp 51-53) USE OF ^{137}Cs GAMMA SOURCE FOR DETECTION OF LEAD TRACES. Shani, G. (Univ. of the Negev, Beersheba, Israel). 1973.

From Israel Nuclear Society annual meeting; Yavne, Israel (26 Jun 1973).

As part of the research on air pollution in the Department of Nuclear Science at the University of the Negev, a method was developed using the nuclear techniques to detect lead, which is ordinarily difficult to detect with activation analysis. The alternative is the x-ray fluorescence. X-ray fluorescence has been used for analysis for a long time. It is based on the measurement of the x rays emitted by an atom after one of its inner electrons has been raised to an excited state by x rays or gamma rays. (INIS)

12521 HIGH SENSITIVITY DETECTION OF SOLUTION CONTAMINANTS BY MeV ION SCATTERING. Meek, R. L. (Bell Telephone Labs., Inc., Murray Hill, NJ). J. Electrochem. Soc.; 121: No. 1, 172-173(Jan 1974).

Rutherford ion backscattering of MeV He ions is a very sensitive technique for detecting surface impurities heavier than the atoms of the substrate. This technique qualitatively identifies the species present, by the energy of the backscattered ions, and quantitatively determines their number, through the number of scattered ions. Silicon wafers were used as substrates for several reagents commonly used in semiconductor device processing. Concentrations were determined by scanning across the wafer area on which the reagent had been placed. (LK)

12522 RADIOISOTOPE ON-STREAM ANALYSIS. Howarth, W. J.; Wenk, G. J.; Wilkinson, L. R. (Australian Mining Development Lab., Adelaide). Can. Mining Met. Bull.; 66: No. 737, 76-83(Sep 1973).

Over a period of three years, a cooperative program in Australia has resulted in the development of radioisotope immersion probes for the on-stream analysis of mineral slurries. Two basic probe types are now available on a commercial basis-fluorescence and absorption probes-and within each type there are a number of variations so that optimum sensitivities can be obtained for elements with atomic number greater than titanium (22), thus covering most metals of interest to modern metallurgy. (auth)

12523 CHOICE OF PHYSICAL PARAMETERS IN CHARGED PARTICLE INDUCED X-RAY FLUORESCENCE ANALYSIS. Herman, A. W.; McNelles, L. A.; Campbell, J. L. (Guelph Univ., Ont.). Int. J. Appl. Radiat. Isotop.; 24: No. 12, 677-688(Dec 1973).

The sensitivities attainable in charged particle induced x-ray fluorescence analysis depend upon choice of particle and energy, beam-handling, target chamber design, and sample mounting. These inter-related factors are investigated systematically. Problems of sample preparation and calibration are discussed very briefly, using x-ray spectra from animal tissue as examples. (auth)

12524 NEUTRON METHODS FOR ON-LINE ANALYSIS. Dibbs, H. P. (Dept. of the Environment, Ottawa); Dalton, J. L. CIM (Can. Mining Met.) Bull.; 66: No. 737, 61-69(Sep 1973).

An account is given of investigations into the application of two neutron methods to the on-line analysis of slurries. One deals with the application of the neutron moisture gauge principle to the determination of the water content of iron oxide slurries, and the other with the application of gamma radiation from thermal-neutron-capture to the determination of the composition of aqueous slurries of iron oxide, copper oxide, zinc oxide, and sulfur. Linear relationships were found between the composition of the slurry and the neutron count-rate in the first study, and between the slurry composition and the prompt-gamma-count-rate in the second study. A mathematical relationship was also developed, which relates changes in the prompt-gamma counts from hydrogen to changes in slurry composition. (auth)

12525 RAPID DETERMINATION OF MULTI-ELEMENTS IN THIN SPECIMENS BY X-RAY SPECTROMETRY. Tominaga, H. (Japan Atomic Energy Research Inst., Ibaraki). Nucl. Instrum. Methods; 114: No. 1, 65-69(1974).

A simple x-ray method for multielement determination in thin specimens was developed in which troublesome preparation of the thin film standards is not required. The x-ray fluorescence count rate of each element is calibrated by calculation with both the count rate of the pure element in saturation thickness and the effective mass-absorption coefficient. Corrections for matrix-absorption effects, if necessary, are made by using a pure-element target. (auth)

12526 ENERGY-DISPERSIVE X-RAY FLUORESCENCE ANALYSIS WITH RADIOISOTOPE EXCITATION. de Neef, J. Ghent; Ghent State Univ. (1973). 130p. Centre d'Etude de l'Energie Nucleaire, Mol, Belgium. (In Dutch).

Thesis (Ph. D.).

The measuring equipment used especially in energy-dispersive x-ray fluorescence is described (i.e., the semiconductor detectors and the amplification and analyzing apparatus). Some important properties of the Si(Li) and Ge(Li) detectors are discussed: the distance between crystal surface and beryllium window, the absolute detection efficiency and the resolution in the low-energy region. The resolution (in eV at FWHM) is 280 eV for the Fe Kα radiation (6.40 keV) with the silicon detector and 230 eV with the germanium detector. Two different radioactive sources are used as primary excitation sources: ^{241}Am and ^{170}Tm. Much attention was paid to the optimization of the geometrical arrangement of source, sample, and detector, because the mutual position of these three components will influence the sensitivity and the signal-to-background ratio. A few applications in the energy dispersive x-ray fluorescence field are described. Determination of rare earths in mixtures of rare earths is confronted with the absorption and enhancement effect, so that a few correction methods were checked. Impurities in pure rare earths were determined by means of the standard addition method. A few synthetic rare-earth mixtures with Nd as major component were analyzed by comparison with a standard sample. (auth)

12527 ANALYSIS OF THREE-COMPONENTS SYSTEMS BY THE METHOD USING BACK-SCATTERED β PARTICLES. Rychvarov, N.; Karamanova, Zh. (Inst. of Physics, Sofia). Rudododobiv Met. (Sofia); 27: No. 4, 25-28(1972). (In Bulgarian).

The possibility of determining barium and iron in barium ores was investigated by the use of the β backscattering method. The method is founded on the dependence between intensity and backscattered radiation and composition of the irradiated sample. The barium ore is considered to be a three-component system compounded from barium, iron, and a third component that combines the available admixtures from aluminum, oxygen, and silicon. The barium and iron content is determined by two successive measurements. The first one, without any filter, counts the β particles reflected from the barium and iron atoms. A strontium source with activity 0.1 mCi is used. The second measurement is done with a filter that passes through mainly the rays reflected from the barium atoms. An aluminium filter is used with thickness of 260 mg/cm^2, as the source activity increases to 0.3 mCi. The standard graphs are prepared using 40 samples with different barium sulfate and Fe_2O_3 content. A summary nomogram is prepared on the basis of the two kinds of measurements. In investigating samples with unknown barium and iron content the two measured values of the reflected radiation represent coordinates of a point from a rectangular coordinate system. The coordinates of the same point in a diamond-shaped grid of the nomogram directly define barium and iron percentage content. The root mean square error for the samples of equal granulometric composition and moisture is 0.6 to 0.8%. The particle reflected radiation is recommended for a rapid determination of barium and iron in

barites, which is done for 10 to 15 min. This method is considered to be available in realizing operative control and regulating the technological process in the barium ore treatment. (INIS)

Separation Procedures

Refer also to abstracts 12623 and 12693.

12528 (ANL-7996, pp 118-121) SEPARATIONS CHEMISTRY. Feb 1973.

In chemistry division annual report, July 1971–June 1972.

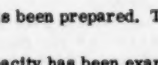
A chromatographic separation method for the isolation of possible new elements (transactinide) from thick targets is reported. A second method is reported for the high-speed, high-efficiency extraction chromatographic isolation of superheavy elements from thin targets. Two extractants were investigated: trilaurylammonium chloride in o-xylene and di(2-ethylhexyl)orthophosphosphonic acid (HDEHP). Results of the separation of (1) Cm(III) from Cf(III) and (2) Es(III) and Fm(III) from Md(III) by the second method using HDEHP are given. Studies on the separation of Th from rare earths and Pa(V) from aqueous HCl by solvent extraction are summarized. (JGB)

12529 (RLO-2225-T-11-4) LIQUID AND GAS PHASE SEPARATIONS II. Progress Report No. 2, October 1, 1972–September 30, 1973. Babb, A. L.; Garlid, K. L. (Washington Univ., Seattle (USA). Dept. of Nuclear Engineering). Nov 1973. Contract AT(45-1)-2225. 86p. Dep. NTIS $6.50.

Investigations were conducted of (1) using spectral analysis of on-line organic volume fraction data for determining basic process information in pulsed, solvent extraction columns and (2) the use of semi-permeable membranes for separating ^{85}Kr from nitrogen. Earlier investigations of extraction column data had shown that anomalies such as incipient flooding could be detected at an early stage of their development by random signal analysis. Column operation was modified to eliminate some sources of extraneous noise and data were recorded and digitally filtered to remove the intrinsic periodic variations that are caused by the pulsing action. Filtered data were carefully analyzed in order to reveal basic process information, such as relative phase velocities and longitudinal dispersion. All efforts, however, were unsuccessful, despite a high level of sophistication in data processing. Process information was apparently masked by dispersion of the pulsing action and by successive disintegration of packets of aqueous and organic phases that occurred in passing through the sieve plates. Data were obtained on separation factors of krypton and nitrogen from a test cell, and were repeatable for a given membrane, but showed great disparity between membranes. The disparity was found to be due to poor quality control of membranes, hysteresis effects following specific pressurization history, and the degree of prestressing to which the membranes were subjected. (auth)

12530 (RT/CHI-(73)5) PREPARATION AND PROPERTIES OF SOME TRIALKYLACETO-HYDROXAMIC ACIDS: STABILIZATION INDUCED BY THE TERTIARY ALKYL GROUP ON THE HYDROXAMIC FUNCTION. Gasparini, G. M.; Polidori, E. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 12 Jul 1973. 37p. (In Italian). Dep. NTIS (U. S. Sales Only) $4.00.

A series of new hydroxamic acids with the general structure:



Alch – C(Alch) – CONHOH has been prepared. Their solubilities, stability, and extractive capacity has been examined. These acids were used to determine the extraction coefficients of ^{59}Fe and ^{239}Pu. (auth)

12531 COLUMN CHROMATOGRAPHIC SEPARATION OF TITANIUM, ZIRCONIUM, AND NIOBIUM. Lee, C.; Yim, Y. C.; Chung, K. S. Daehan Hwahak Hwoejee; 17: No. 1, 15-19(1973).

A method was developed for the separation of titanium, niobium, and zirconium together in a group from the coexisting ions of various metals such as iron, cobalt, nickel, yttrium, and rare earths by means of the cation exchange column using α-hydroxyisobutyric acid as the eluent. In the course of the present investigation, it was found that the tailing phenomena of zirconium were attributable to the hydroxide precipitation made prior to the elution. For example, if zirconium was precipitated by sodium hydroxide, the tailing of zirconium became very serious in contrast to the results reported by others. How these tailing phenomena of zirconium were prevented and how a practical procedure for the separation of these ions was achieved using the ion-exchange method are described. Using the present method the nuclides of ^{90m}Y and ^{90}Y were separated with radiochemical purity from the irradiated zirconium. (Korean Sci. Abstr.)

12532 EXTRACTION OF U(VI) FROM OXALATE SOLUTIONS USING TETRADECYLAMMONIUM OXALATE. Kuzina, M. G.; Lipovskii, A. A. Zh. Neorg. Khim.; 18: No. 7, 1902-1906 (Jul 1973). (In Russian).

The extraction of U(VI) from oxalate solutions at various pH values was studied. It was shown that, as a function of the extractant and uranium concentration ratios, the latter was extracted in the form of different acido and hydroxyacido complexes. With excess extractant, the compounds were $(R_4N)_2UO_2Ox_2$ at low pH values of the aqueous solution and $(R_4N)_2UO_2Ox(OH)_2$ at high values. When there was a deficit of the extractant, different hydroxyacido complexes were formed. (tr-auth)

12533 SEPARATION OF ZIRCONIUM AND HAFNIUM THIOCYANATE COMPLEXES BY EXTRACTION INTO NEUTRAL ORGANOPHOSPHORUS COMPOUNDS (NOPC). Pepelyaeva, E. A.; Sinegribova, O. A.; Shostenko, N. A.; Yagodin, G. A. J. Appl. Chem. USSR (Engl. Transl.); 46: No. 6, 1387-1390(Jun 1973).

Translated from Zh. Prikl, Khim.; 46: No. 6, 1301-1305(Jun 1973).

Extractive separation of Zr and Hf thiocyanates is generally effected from hydrochloric or sulfuric acid solutions. The distribution and separation coefficients depend to a considerable extent on the composition of the aqueous phase. In extraction from hydrochloric acid solutions into NOPC, metal extraction is considerable but the separation coefficient is very low; and use of sulfuric acid solutions leads to a sharp decrease of extractability, but with more effective separation. The causes of the influence of various factors on separation of Zr and Hf complexes are discussed. (auth)

12534 SEPARATION OF FLUORINE FROM ZIRCONIUM AND HAFNIUM HYDROXOFLUORIDES. Godneva, M. M.; Motov, D. L. J. Appl. Chem. USSR (Engl. Transl.); 46: No. 7, 1537-1541(Jul 1973).

Translated from Zh. Prikl. Khim.; 46: No. 7, 1438-1443(Jul 1973).

For separation of fluorine by electrodialysis it is recommended that membranes which are inert with respect to zirconium fluoride complexes be used. Intensive separation of fluorine from zirconium (or hafnium) hydroxofluoride can be achieved by high-voltage electrodialysis at voltages above 600 V. The existence of previously unknown zirconium hydroxofluoride complexes with atomic ratios F/Zr = 0.6 and 0.2 was demonstrated. Some separation of zirconium and hafnium on EDE-10P resin was achieved as the result of preferential elution of the hafnium fluoride complex by sulfuric acid solutions. (auth)

12535 HIGH SPEED LIQUID CHROMATOGRAPHY. Rajcsanyi, P. M.; Oetvoes, L. (Central Research Inst. for Chemistry, Budapest). Separ. Purif. Methods; 2: No. 2, 361-441(1973)

High-speed chromatographic separation methods are reviewed. Instrumentation used in liquid chromatography is described, including radioactivity detectors. Analytical applications to various compounds are discussed. (LK)

Inorganic, Organic, and Physical Chemistry

Refer also to abstracts 13814, 15157, 15160, 15162, 15166, 15170, 15171, and 15173.

Chemical and Physicochemical Properties

Refer also to abstracts 12624, 12631, 12636, 15026, 15098, 15134, 15136, 15137, 15144, 15146, 15147, 15149, 15153, 15156, 15165, 15167, 15178, and 15187.

12536 (ANL-7996, pp 98-102) LOW-TEMPERATURE CALORIMETRY. Feb 1973.

In chemistry division annual report, July 1971–June 1972.

The heat capacity of solid XeF_2 was measured at 5 to 350°K, and various thermodynamic functions calculated from them are reported. Standard Gibbs energy of formation of gaseous XeF_2 and the equilibrium constant for formation of gaseous XeF_2 from the elements are tabulated. Measurements on the enthalpy of solution of Cs_2O and its heat capacity between 5 and 350°K were made. (JGB)

12537 (BARC-690, pp 51-54) CHEMICAL DEVELOPMENT WORK ON MOLTEN SALT BREEDER REACTOR CONCEPT. Sood, D. D.; Iyer, P. N.; Prasad, R.; Vaidya, V. N.; Roy, K. N.; Venugopal, V.; Venkataramana, P.; Singh, Z.; Nair, P. S.; Patil, B. N.; Ramanish, M. V. 1973.

Research progress is reported on chemical development work

on molten salt breeder reactor concepts including studies on the solubility of PuF_3 in $LiF-BeF_2-ThF_4$ and $LiF-ThF_4$. (DHM)

12538 (BARC-690, pp 54-60) VAPOUR PRESSURE MEASUREMENTS OF MATERIALS OF INTEREST IN MOLTEN SALT REACTOR. Prasad, R.; Venugopal, V.; Iyer, P. N.; Sood, D. D. 1973.

Research progress is reported on vapor pressure measurements using the transpiration technique in which magnesium is used for standardization. Results are reported for vapor pressure measurements of Mg-Bi alloys. (DHM)

12539 (BARC-690, pp 128) MOESSBAUER STUDIES ON THE COMPLEX SALTS OF FERROUS SULPHATE. Madraswala, K. H.; Almoula, A. I.; Mathews, C. K. 1973.

12540 EXCHANGE CHARACTERISTICS OF HYDRATED ZIRCONIA. Hallaba, E.; Misak, N. Z.; Salama, H. N. (Atomic Energy Establishment, Cairo). Indian J. Chem.; 11: No. 6, 580-583(Jun 1973).

Equilibria of various cations and anions on hydrated zirconia were studied. The kinetics of uptake of different alkali metal ions by zirconia show that the affinity of various ions to zirconia increases with the valency. All the alkali cations show the same affinity at 0·1N concentration of their hydroxide solutions. At a concentration 0·01N, the affinity is in the order $K^+ > Na^+ > Li^+ > Cs^+$. The rates of exchange of all the alkali metal ions are particle diffusion-controlled over the concentration range 0·01-1M of the alkali metal chlorides. The effective diffusion coefficients of the exchange reactions decrease in the order $Cs^+ > K^+ > Li^+ > Na^+$. Such anomalous patterns of affinity and diffusion coefficients for the alkali ion systems may probably be attributed to a change in cation hydration in the exchange processes. (auth)

12541 STABILITY STUDIES OF DISPERSE SYSTEMS USING BETA-RADIATION BACKSCATTERING. Suspension of Inorganic Compounds in Water and 2% Water Solution of Tween 20^R. Jombik, J.; Jilkova, E. (Komensky Univ., Bratislava). Farm. Obz.; 41: No. 7, 303-308(1972). (In Slovak).

A possible use of backscattering of beta radiation in observing adsorption at the interface of the solid and the fluid phases, where the solid phase is hydrophilic was studied. As the external phase, water and a 2% aqueous solution of Tween 20^R were used; the internal phase consisted of calcium carbonate, zinc carbonate, and barium carbonate. (Nucl. Sci. Abstr. Czech.)

12542 METHOD AND APPARATUS FOR THE PRODUCTION OF METHANE. Webster, H.; Heath, J. A. (to Clarke Chapman-John Thompson Ltd.). British Patent 1,333,251. 10 Oct 1973. Filed date 11 Dec 1970. 6p.

A method is described for the production of CH_4 from CO_2 and H_2 using a catalyst such as Ru. It has particular applicability for the on-site production of CH_4 for gas-cooled reactors where a source of CO_2 and H_2 is available. After the CO_2 and H_2 have been passed over the catalyst water is removed from the CH_4 by a condensation stage. The gas mixture is then again passed over the catalyst to increase the yield of CH_4. The catalyst may be Ru, Pt, Co, or Ni. A reaction temperature of 340°C is employed. Apparatus for performing the method is described. (UK)

12543 STABILITY AND STRUCTURE OF GASEOUS METAL FLUORIDE MOLECULES. Charkin, O. P. Zh. Neorg. Khim.; 18: No. 9, 2307-2315(Sep 1973). (In Russian).

Within the framework of the "atoms and molecules" method, questions are considered of the relative strength of the energy of the successive rupture of M-F bonds and the nature of the change in ionization potential of gaseous metal fluorides, MF_x, as a function of location of the metal in the periodic system and its valence. The geometrical structure (symmetrical type) of these molecules is examined and the results are compared with experimental data. (tr-auth)

12544 PHYSICO-CHEMICAL PROPERTIES OF TECHNETIUM(IV) HEXABROMIDE COMPLEXES. Zaitseva, L. L.; Konarev, M. L; Il'yashenko, V. S.; Vinogradov, I. V.; Shepel'kov, S. V.; Kruglov, A. A.; Chebotarev, N. T. Zh. Neorg. Khim.; 18: No. 9, 2410-2413(Sep 1973). (In Russian).

Infrared spectra of Me_2TcBr_6 (Me = K, NH_4, Rb, Cs) were determined and studied. The displacement of the wave maxima corresponding to the fundamental Tc-Br wave in the low-frequency region was shown to be related to a change in the ion radius of the alkali cation. X-ray studies showed that Rb_2TcBr_6 and $CsTcBr_6$ have a cubic face-centered lattice with periods $a = 10.461 \pm 0.002$ and 10.650 ± 0.003 Å, respectively. (tr-auth)

Isotope Effects

12545 INFRARED STUDIES OF APATITES. II. Preparation of Normal and Isotopically Substituted Calcium, Strontium, and Barium Hydroxyapatites and Spectra-Structure-Composition Correlations. Fowler, B. O. (National Inst. of Dental Research, Bethesda, MD). Inorg. Chem.; 13: No. 1, 207-214(Jan 1974).

Procedures are described for preparation of calcium, strontium, and barium hydroxyapatites, their deuterated analogs, and calcium hydroxyapatite enriched with isotopic calcium with particular emphasis on purity, stoichiometry, crystal perfection, and gravimetrically monitoring the apatite composition. The effects of low temperature and differences in physical properties of the apatites on the infrared vibrational frequencies are discussed. Shifts in the internal phosphate modes to higher frequencies, in the barium-strontium-calcium hydroxyapatite sequence and also on cooling, are attributed primarily to increased interphosphate repulsion concomitant with lattice contraction. Causes for variation in the frequencies and intensities of the OH modes are considered from several viewpoints including the presence of weak OH-O bonding which is neither conclusively established nor rejected. Marked increases in OH band intensities in the barium-strontium-calcium hydroxyapatite sequence are attributed to differences in OH bonding rather than to other effects. (auth)

12546 STUDIES OF 2,4-DIAZAPENTADIENES. Sim, S. K. London, Ont.; Univ. of Western Ontario (1973). National Library of Canada, Ottawa.

Thesis (Ph. D.).

The preparations, structures and reactions of a series of 1,3,5-triaryl-2,4-diazapentadienes 1 and their isomers was investigated. Also, the mechanism of the cyclization and 1,3-proton shift of 1 catalyzed by phenyllithium and by potassium methoxide-methanol was studied. On the basis of substituent effects, hydrogen-deuterium exchange, isotope effects and solvent effects, it was deduced that both the cyclization and prototropy of 1 involve a common W-shaped carbanion which rapidly cyclizes. The primary isotope effects for the conversion of 3 to carbanion (k_2) and the protonation of the carbanion (k_{-2}) were estimated to be ≥ 5 and 2 ± 0.3 respectively. (Diss. Abstr. Int., B)

12547 PHENYL N-METHYLACETIMIDATE IN H_2O AND D_2O AND ITS REACTIONS WITH NUCLEOPHILES. Pocker, Y.; Beug, M. W.; Stephens, K. L. (Univ. of Washington, Seattle). J. Amer. Chem. Soc.; 96: No. 1, 174-180(9 Jan 1974).

The chemical decomposition of phenyl N-methylacetimidate (PNMA) is examined over the pH (pD) range 2-13 in both H_2O and D_2O; the major hydrolysis products above pH 5 are phenol (or phenolate) and N-methylacetamide. Throughout the range examined, the protonated imido ester appears to be the primary reactive species. Its water reaction is faster in H_2O than in D_2O, $k_{H_2O}/k_{D_2O} = 2.17$, whereas catalysis by nucleophilic components is found to be the same in both solvents. Azide and cyanide ions are powerful nucleophiles toward the protonated imido ester, the product from reaction with azide being 1,5-dimethyltetrazole which does not hydrolyze further. On the other hand, nucleophilic catalysis by imidazole leads to the formation of the unique compound imidazyl N-methylacetimidate which subsequently hydrolyzes to N-methylacetamide and imidazole. (auth)

12548 HYDROLYSIS OF D-GLUCONO-δ-LACETONE, II. Comparative Studies of General Acid-Base Catalyzed Hydrolysis of Methylated Derivatives. Pocker, Y.; Green, E. (Univ. of Washington, Seattle). J. Amer. Chem. Soc.; 96: No. 1, 166-173(9 Jan 1974).

Polarimetric methods have been used to study the hydrolysis of tetra-O-methylglucono-δ-lactone (2), tetra-O-methylmannono-δ-lactone (3), and tri-O-methyl-2-deoxyglucono-δ-lactone (4) over a wide range of pH values at 25.0. The reactions of 2-4 are subject to general base catalysis with Brønsted exponents, β, of 0.43, 0.41, and 0.30, respectively. The Brønsted exponents, α, for the hydrolysis of 2 and 4 are 0.43 and ca. 0.6, respectively. General acid catalysis in the hydrolysis of lactone 3 was not detectable. With the exception of general acid catalysis, the hydrolytic behavior of δ-lactones is quite similar to that of straight-chain alkyl esters which are activated in the acyl fragment by electron-withdrawing groups. The similarities include large negative entropies of activation for the water-catalyzed reactions, comparable hydroxide ion activation parameters, large deuterium isotope effects, Brønsted exponents near 0.5, and low susceptibility to nucleophilic catalysis. The strained half-chair conformation "activates" δ-lactones. The effects of substitution in the 2 position on the reactivity of δ-lactones are discussed, and an explanation is presented for the absence of oxygen exchange during the hydrolysis of δ- and γ-lactones. (auth)

Isotope Exchange and Isotope Separation

Refer also to abstract 15097.

12549 CHEMICAL SEPARATION OF HYDROGEN ISOTOPES USING DEUTERIUM LAMPS. Basov, Yu. G.; Greben'kov, V. S.; Oginskaya, E. A. At. Energ. (USSR); 35: No. 2, 132-134(Aug 1973). (In Russian).

In experiments on the photochemical reaction of hydrogen and oxygen to form water, using a deuterium lamp, deuterium accumulated in the residue of the incompletely converted gas with a coefficient of separation of 2.3. After 2 to 3 hr, the enrichment coefficient was 1.965 to 2.36. This is a greater enrichment than when a low-pressure mercury lamp is used. (auth)

12550 ISOTOPIC EXCHANGE OF ^{18}O WITH THE OXYGEN OF NIOBIUM(V) OXIDE. Ross, R. A.; Klissurski, G.; Griffith, T. J. (Lakehead Univ., Thunder Bay, Ont.). Z. Phys. Chem. (Frankfurt); 86: No. 1/2, 50-58(1973).

The kinetics of the exchange of gas-phase oxygen-18 with the oxygen of niobium(V) oxide has been studied in a "static-circulation" apparatus. Both the surface and bulk oxygen in the oxide possess low mobility and exhibit energetically uniform behaviour. From the experimental data for the specific rates of exchange, at 620 to 700°C, an activation energy of 61 kcal × $mole^{-1}$ was calculated. The reaction order was 0.6 in the oxygen pressure range 5 to 30 torr. Kinetic data are interpreted. Relationships between the low oxygen mobility in a transition metal oxide and the degree of covalency of the metal/oxygen bond are discussed. (GE)

Feed Materials Processing

Refer also to abstract 12639.

12551 (INIS-mf-943) ZIRCONIUM AND URANIUM RECOVERIES FROM A $ZrSiO_4$ AND ZrO_2 MINERAL (CALDASITO) FROM THE POCOS DE CALDAS PLATEAU, THE STATE OF MINAS GERAIS, BRAZIL. Brown, A. E. P. (Sao Paulo Univ. (Brazil). Escola Politecnica). 1972. 116p. (In Portuguese). INIS.

Thesis.

A commercial-grade zirconium dioxide (Zr, Hf)O_2 and a sodium diuranate (SDU) or ammonium diuranate (ADU) processing is presented. These compounds are obtained from the Caldasito, from the Pocos de Caldas Plateau in the southern part of the State of Minas Gerais, Brazil. The processing scheme is developed in three steps: the chemical opening of the ore, the uranium-zirconium separation and the zirconium purification. The uranium-zirconium separation takes place by a liquid-liquid extraction in the TBP-varsol-HNO_3-H_2O system, using as organic phase a mixture of TBP 36% v/v-varsol. The yield of the uranium extraction, in a single and discontinuous stage is higher than 80% in U_3O_8. The zirconium extraction by the tributyl phosphate (TBP) in dilute nitric acid is negligible. The raffinate (zirconyl nitrate) is purified by an ion-exchange operation with a strong cationic resin. Aluminium, titanium, and iron are the most important impurities in the aqueous solution. The zirconium nitrate is transformed into a colloidal solution, the zirconium being not retained by the column. The zirconium in the effluent is precipitated by ammonium hydroxide and calcined to a commercial-grade zirconium dioxide. By this procedure it is possible to produce a commercial-grade oxide higher than 97% in ZrO_2. (INIS)

12552 PROCESS FOR RECOVERING URANIUM. Yano, M.; Yamamoto, I.; Yasuhira, N. (to Kuraray Co., Ltd.). US Patent 3,778,498. 11 Dec 1973. Priority Date 29 Dec 1969, Japan. 8p.

A process for recovering uranium from a uranium-bearing aqueous solution is described. The process involves contacting a titanated polyvinyl alcohol in the form of particles, flakes, films, filaments, fibers, battings or fabrics with a uranium-bearing aqueous solution to absorb the uranium. The uranium is then desorbed with an aqueous solution of sodium carbonate or ammonium carbonate. (LK)

Radiation Chemistry

Refer also to abstracts 12720, 12999, and 13055.

12553 (ANL-7996, pp 58-72) RADIATION CHEMISTRY AND PHOTOCHEMISTRY. Feb 1973.

In chemistry division annual report, July 1971–June 1972.

Picosecond pulse radiolysis techniques continue to be used in an attempt to clarify basic processes in the radiolysis of aqueous solutions, in particular, in the time range covered by the spur diffusion model, 10^{-12} to 10^{-8} sec. Qualitatively, preliminary results substantiate the postulate of a nonhomogeneous reaction occurring in localized regions or spurs, but quantitatively, they differ markedly in the initial decay of e_{aq} from diffusion-model calculations. Studies on electron transfer and luminescence in irradiated tris(bipyridyl)ruthenium(III) are continuing. Rate constants were determined for the reaction, $M^{2+} + X_2^- \rightarrow M(III) + 2X^-$, where M = Cr or V and X = Cl, Br, or I. Reactions with V^{2+} are of the outer-sphere type; those with Cr^{2+} are of the inner-sphere type. In studies on the γ radiolysis of aqueous solutions of methane, results indicate that yields of the higher hydrocarbons are substantially affected by the presence or absence of N_2O and by variations in pH. Kinetics of the pulse radiolysis of 6M NaOH at 77°K were studied via the trapped electron spectrum. Rate constants are tabulated for the reactions of 13 organic and inorganic gases with the hydroxyl radical in electron-irradiated water vapor. In studies on aerosol chemistry, a new research tool was developed for obtaining the size and number distribution of condensation nuclei. Details and a schematic diagram of the Argonne Condensation Nuclei Discriminator, which makes possible the calculation of the growth function of the light-scattering fog particle as it grows in size from 0.5 to 10 μm are given. Initial results on the β-initiated oxidation of SO_2 indicate that condensation nuclei are readily created in humid air containing ppM levels of SO_2, and that CO, CH_4, and other organic hydrocarbons at certain concentrations appreciably diminish the number of nuclei formed. (JGB)

12554 (ANL-7996, pp 143-152) THEORETICAL CHEMISTRY. Feb 1973.

In chemistry division annual report, July 1971–June 1972.

Progress is reported in theoretical studies of systems of atmospheric interest, scattering theory and dynamics, calculation of atomic and molecular polarizabilities, structure and spectra of diatomic molecules, the evaluation of van der Waal's forces, chemical-reaction surfaces, application of computer graphics to the display of molecular processes, and development of theoretical techniques and computing systems. Theoretical studies in radiation chemistry included analysis of data on the decay of solvated electrons and the kinetics of gas-phase reactions. (JGB)

12555 (BARC–690, pp 94-109) RADIATION CHEMISTRY. 1973.

Research progress is reported on radiation chemistry of heavy elements that includes the following topics: radiation chemistry of plutonium in nitric acid solutions (spectrophotometric analysis and γ radiolysis of Pu(IV) and Pu(VI) in nitric acid solution); EPR studies of intermediates formed in radiolytic reactions with aqueous medium; two-phase radiolysis and its effect on the distribution coefficient of plutonium; and radiation chemistry of nitric acid. (DHM)

12556 (BARC–690, pp 115-128) SPECTROSCOPIC STUDIES. 1973.

Research progress is reported on spectroscopic studies of heavy elements; topics considered are: rate of energy transfer from UO_2^{2+} ion to Eu^{3+} ion in solution and the effect of anion concentration; fluorescence and absorption spectra of Tb^{3+} ion in terbium aluminum garnet; EPR study of radiation effects on solids (potassium and ammonium oxalate single crystals) and potassium pyrosulfate crystals; and study of VO^{2+} in magnesium acetate tetrahydrate single crystals. (DHM)

12557 (CEA-CONF-2400) APPLICATION OF POLYMERIZATION TECHNIQUES TO THE TREATMENT OF WOODS GORGED WITH WATER. Detanger, B.; Ramiere, R.; de Tassigny, C.; Eymery, R.; de Nadaillac, L. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. des Radioelements). May 1973. 15p. (In French). (CONF-730575-4). Dep. NTIS (U. S. Sales Only) $3.00.

From international conference on application of nuclear data in the field of work of art; Rome–Venice, Italy (24 May 1973).

Wooden objects from stagnant or flowing waters have great value for the study of prehistory and protohistory. The preservation of these objects offers great difficulties as the elimination of the water causes them to crack, warp, or sag irreversibly. Ancient water-saturated woods were studied botanically, physicochemically, and biologically in order to develop techniques for their preservation in their original form. The studies showed that the simultaneous use of a technique of liquid-liquid extraction of the water and the polymerization under γ radiation of the monomer introduced by substitution offers possibilities which merit a more in-depth study. (JSR)

12558 (CEA-CONF-2401) APPLICATION OF POLYMERIZATION TECHNIQUES TO THE TREATMENT OF WOODEN OBJECTS. Detanger, B.; Ramiere, R.; de Tassigny, C.; Eymery, R.; de Nadaillac, L. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. des Radioelements). May 1973. 14p. (In French). (CONF-730575-1). Dep. NTIS (U. S. Sales Only) $3.00.

From international conference on application of nuclear data in the field of work of art; Rome–Venice, Italy (24 May 1973).

The preservation of cultural wooden objects is often a costly and time-consuming process. A method based on γ irradiation was developed as a rapid and economical substitute. γ irradiation offers two advantages. It kills the insects, bacteria, and various parasites that infect woods and it strengthens wood by the polymerization of a resin previously introduced in the wood grains. This method is described in some detail. (JSR)

12559 (CEA-CONF-2402) APPLICATION OF POLYMERIZATION TECHNIQUES TO THE TREATMENT OF STONE. Detanger, B.; Ramiere, R. de Tassigny, C.; Eymery, R.; de Nadaillac, L. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. des Radioelements). May 1973. 15p. (In French). (CONF-730575-2). Dep. NTIS (U. S. Sales Only) $3.00.

From international conference on application of nuclear data in the field of work of art; Rome–Venice, Italy (24 May 1973).

A method for the preservation of stone objects by as complete as possible impregnation of the stone with a synthetic resin which is then polymerized "in situ" by γ radiation was developed. At the present time the method can only be applied to detachable parts. The results obtained are promising. The method augments the mechanical properties and, by reducing to a great degree the circulation of water in the stone, it prevents the degradation by salts. (JSR)

12560 (CEA-CONF-2403) CONSIDERATIONS ON THE DEVELOPMENT OF THE UTILIZATION OF NUCLEAR TECHNIQUES IN THE CONSERVATION OF CULTURAL POSSESSIONS. de Nadaillac, L.; Cornuet, R. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. des Radioelements). May 1973. 10p. (In French). (CONF-730575-5). Dep. NTIS (U. S. Sales Only) $3.00.

From international conference on application of nuclear data in the field of work of art; Rome–Venice, Italy (24 May 1973).

The "Nucleart" project has the purpose of adapting nuclear techniques to the preservation of cultural objects. The activities in the preservation of wooden, stone, and water-impregnated objects are briefly described. In the latter case the water must be replaced with a monomer which is then polymerized by irradiation. The use of radioactive tracers is briefly indicated. (JSR)

12561 (LA-5436-MS) CONVERSION OF PARA TO ORTHOHYDROGEN IN A GAMMA-RAY AND NEUTRON RADIATION FIELD. Conant, J. W.; Edeskuty, F. J.; Huston, J. E.; Thome, F. V. (Los Alamos Scientific Lab., N. Mex. (USA)). Nov 1973. Contract W-7405-eng-36. 8p. Dep. NTIS $4.00.

The radiation-induced conversion of para to orthohydrogen was investigated at pressures between 150 and 2200 psig (1 to 15×10^6 N/meter^2) at three temperatures: 77°K (LN_2), 200°K (dry ice), and 300°K (ambient). Two radiation dose levels were studied: gamma rays only at 8×10^6 rads and a combination of 5×10^{14} n/cm^2, E > 1 MeV, plus gamma rays at 8×10^5 rads. The conversion at LN_2 temperature was nearly zero in all cases. (auth)

12562 TEMPERATURE-DEPENDENT ELECTRON SPIN RESONANCE SPECTRUM OF CHLORINE TRIOXIDE RADICALS TRAPPED IN MAGNESIUM PERCHLORATE. Shimokoshi, K.; Mori, Y. (Tokyo Inst. of Tech.). J. Phys. Chem.; 77: No. 26, 3058-3061(20 Dec 1973).

The ESR spectrum of the ClO_3, produced by the γ-irradiation of $Mg(ClO_4)_2$ at room temperature, and its dependence on temperature were studied. It was found that at temperatures lower than −80°C the spectra of ClO_3 showed the presence of two ClO_3 radicals, while the spectra obtained at higher temperatures consisted of a single component. From the experimental results and the CNDO molecular orbital calculations of the radical, an inversion, together with a lattice vibration, is proposed for the molecular motion, which is operative in the system of ClO_3 trapped in $Mg(ClO_4)_2$ lattice, to interpret the observed temperature dependence of the spectrum. A CNDO treatment for the electronic energy of ClO_3 showed a reasonable trend as a function of the bond angle (∠OClO), in particular, for the spin densities and hyperfine splittings of ClO_3. (auth)

12563 CYCLOPOLYMERIZATION. I. An Electron Spin Resonance Study of Irradiated N-Methyldimethacrylamide. Kosaira, T. (Fukui Univ., Japan); Morishita, K.; Yamaoka, H.; Aida, H. J. Polym. Sci., Polym. Lett. Ed.; 11: No. 6, 347-350 (Jun 1973).

The mechanism of cyclopolymerization was studied by measuring ESR spectra of propagating radicals produced in N-methyldimethacrylamide by gamma irradiation from ^{60}Co. Polymerization of this compound gives a five-membered ring as a main repeating unit and a six-membered ring as a minor repeating component. Results from the ESR study indicate that the rate determining step of the solid-state cyclopolymerization of N-methyldimethacrylamide is an intramolecular cyclization reaction and that the cyclization proceeds in a stepwise way. (LK)

12564 MOLECULAR WEIGHT DISTRIBUTION AND MOLECULAR STRUCTURE OF POLYETHYLENE PRODUCED BY RADIATION-INDUCED POLYMERIZATION. Yamaguchi, K.; Wada, T.; Maruyama, S.; Takehisa, M. (Japan Atomic Energy Research Inst., Takasaki). J. Polym. Sci., Polym. Phys. Ed.; 11: No. 8, 1573-1584(Aug 1973).

The molecular weight distribution of polyethylene produced by radiation was calculated according to a kinetic scheme. The calculated molecular weight distribution was compared with the results deduced from gel-permeation chromatography. The observed distribution curve from GPC was broader and showed a lower degree of polymerization than the calculated one. Discrepancies between observed and calculated curves can be explained if the polymer contains nonsteady-curve products and if the reaction mechanism includes chain transfer to dead polymer. By this reaction long-chain branching would occur. Several long-chain branches per polymer molecule were indeed found, as inferred from solution properties. (auth)

12565 THERMAL DECAY KINETICS IN GAMMA IRRADIATED SYSTEMS: SODIUM HYDROXIDE AQUEOUS GLASS, Di-p-TOLYL CARBONATE AND N-HYDROXYUREA. Lembke, R. R. Detroit; Wayne State Univ. (1973). 333p. University Microfilms Order No. 73-31,744.

Thesis (Ph. D.).

The thermal decay kinetics of ^{60}Co, γ-irradiated 10 M NaOH glass at 77°K were studied in the dose range from 0.2 to 2.0 Mrad. These samples decayed in the temperature range 150 to 180°K. The solutions of Waite's general diffusion equation for the Smoluchowski boundary condition, the radiation boundary condition, the initial uniform distribution and the initial correlated-pair distribution were tested with the decay data. The various solutions gave no unique fit of the decay data. The decay of the e_s^- produced by photoionization in 10 M NaOH followed the equation derived by Waite for the radiation boundary condition and an initial Gaussian distribution for correlated pairs. The failure of this same solution for the γ-irradiated samples is explained in terms of diffusion of cross-correlated pairs within the same spur. On the basis of a proposed spur model, an empirical equation is arrived at which related the isothermal decay temperature and the dose to the isotherm decay time, t_{ti}, after which the decay is exponential. The relative concentration at the isotherm decay time, t_{ti}, is also a function of the dose, isotherm temperature and t_{ti}. The thermal decay kinetics of ^{60}Co, γ-irradiated di-p-tolyl carbonate powder and N-hydroxyurea crystals were studied. Radical pairs were found in these compounds on irradiation. The thermal decay kinetics of these radicals and the isolated radicals were investigated. The radical pairs decay by simple first-order kinetics in each case. From this evidence, it is concluded that the radical pairs decay by one hop processes in the solid state. The radical pairs in the di-p-tolyl carbonate powder are found to decay together in the temperature range 130–150°K, while the radical pairs of the N-hydroxyurea single crystal were found to decay apart with a quantitatively correlated increase in isolated radicals. (Diss. Abstr. Int. B)

12566 FREE RADICALS IN IRRADIATED OLEIC ACID. Avakyan, Ts. M.; Veibetsan, K. F.; Dertinger, G. (Kernforschungszentrum, Karlsruhe, Ger.). Biol. Zh. Arm.; 26: No. 1, 3-6(Jan 1973). (In Russian).

Electron paramagnetic resonance was used to study the free radicals formed by γ irradiation (^{60}Co) of oleic acid at 77°K in a rare gas atmosphere. The radiation yield of radicals and molecular hydrogen was determined. The presence of R and ROO radicals was observed. These radicals undoubtedly play an important role in radiation damage in oxygen atmospheres. (tr-auth)

12567 OPTICAL ABSORPTION AND LUMINESCENCE OF X-IRRADIATED ALKALI SULFATES DOPED WITH Cd^{2+} OR Zn^{2+}. Kaira, M.; Laiho, R. (Univ. of Turku, Finland). Ann. Acad. Sci. Fenn., Ser. A VI; 6: No. 405, 1-10(1973).

Cadmium- and zinc-doped alkali sulfate crystals were x-irradiated at room temperature and investigated by optical absorption, emission, and circular dichroism methods. A strong absorption band was identified at 250 nm in the irradiated K_2SO_4, Rb_2SO_4, and Cs_2SO_4 crystals. When excited at 340 nm, the irradiated cadmium-doped crystals emitted light with the peak of the emission band at about 580 nm. These data and the observed circular dichroism of the absorption were assigned to the formation of perturbed O_2^- molecule-ions as a result of x-irradiation. Similar properties were not observed in doped Na_2SO_4 crystals. (auth)

12568 POLYMERIZATION OF ISOPRENE AND STYRENE BY APPLICATION OF RECOIL REACTION IN THE PRESENCE OF DECABORANE. Tanaka, T.; Okuzumi, I.; Matsuda, T.; Kimijima, K.; Akutsu, K. (Saitama Univ., Urawa, Japan). Sci. Eng. Rep., Saitama Univ., Ser. C; No. 4, 25-26(Dec 1970). (In Japanese).

Isoprene and styrene polymerized to polyisoprene, polystyrene, respectively, in good yields, when the monomers including a catalytic amount of decaborane ($B_{10}H_{14}$) were irradiated by neutron fluxes at 2 to 8×10^{13} n/cm^2 · sec and 25°C for few minutes. No polymerization was observed with the absence of $B_{10}H_{14}$ in the reactants. (JA)

12569 RADIOINDUCED CROSSLINKING OF POLYETHYLENE IN THE PRESENCE OF VARIOUS ACETYLENIC COMPOUNDS. Hagiwara, M.; Tagawa, T.; Tsuchida, E.; Shinohara, I.; Kagiya, T. (Japan Atomic Energy Research Inst., Takasaki). J. Polym. Sci., Polym. Lett. Ed.; 11: No. 10, 613-617(Oct 1973).

The crosslinking reaction of polyethylene was investigated by exposing its film samples to ^{60}Co γ rays in the presence of acetylene or its higher (C_3-C_5) derivatives and in the presence of some fluorinated acetylenes. Based on the ir spectra, a chain scheme for the reaction in the presence of acetylenic compounds is proposed. (LK)

12570 STRUCTURE OF METHYL METHACRYLATE–VINYLENE CARBONATE COPOLYMERS PREPARED BY A RADIATION-CHEMICAL METHOD. Zaitseva, N. K.; Klimova, O. M.; Kostenko, V. V. J. Appl. Chem. USSR (Engl. Transl.); 46: No. 5, 1236-1238(May 1973).

Translated from Zh. Prikl. Khim.; 46: No. 5, 1160-1162(May 1973).

γ irradiation of a mixture of polymethyl methacrylate and vinylene carbonate produces graft copolymers of vinylene carbonate and methyl methacrylate. The vinylene carbonate units are grafted to the polymethyl methacrylate chain at the points of removal of ester groups. These copolymers have improved thermal stability and resistance to ionizing radiations. (LK)

12571 STUDIES ON THE MECHANISM OF CHEMICAL RADIOPROTECTION BY DIMETHYL SULFOXIDE. Reuvers, A. P.; Greenstock, C. L.; Borsa, J.; Chapman, J. D. (Atomic Energy of Canada Ltd., Pinawa, Manitoba). Int. J. Radiat. Biol.; 24: No. 5, 533-536(Nov 1973).

Measurements were made of rate constants for the reaction of OH with DMSO (dimethyl sulfoxide) and various other radioprotectors. Pulse radiolysis experiments were made with a 4-MeV Van de Graaf generator delivering 50-nsec electron pulses in the range 0.5 to 5 Krads, using competition kinetics with ferrocyanide and thiocyanate as competitive solutes. Rate constants for the reactions of OH with the following compounds were determined:- N-amyl alcohol, isoamyl alcohol, phenethyl alcohol, isobutanol, glycerol, inositol, ribose, DMSO, tert-butanol, ethanol, isopropanol. The rate constant for the reaction of eaq^{-1} with DMSO was also measured and found to be less than $10^7 M^{-1}s^{-1}$. The rate constants were also determined in a steady-state radiation-chemical system, using DNA as the radiation target for radiosensitizer binding to nitrofurazone. The following OH scavengers were found to inhibit the amount of radioactivity bound to the DNA, inhibition increasing with increasing scavenger concentration, but being independent of sensitizer concentration: tert-butanol, ethanol, isopropanol, isobutanol, isoamyl alcohol, DMSO. A comparison of the two sets of data showed good correlation for the alcohols, but the value obtained for $K_{OH+DNA} = 3 \times 10^9 M^{-1}s^{-1}$ was lower than the rate constant of $5.2 \times 10^9 M^{-1}s^{-1}$ determined with pulse radiolysis by the authors previously [Chapman, J. D. et al., Radiat. Res. 53, 190 (1973)]. It is suggested that the results for DMSO indicate that either DMSO is more effective in competing for OH with DNA than it is with low molecular weight solutes, or that its absolute rate-constant with OH is $\sim 1.2 \times 10^{10} M^{-1} s^{-1}$. (UK)

12572 THERMAL NEUTRON CAPTURE EFFECTS IN VITAMIN B_{12}. Blackburn, R.; Jackson, S. W.; Keating, A. M.; Phillips, G. O.; Trivedi, M. A. (Univ. of Salford, Eng.). Int. J. Radiat. Phys. Chem.; 5: No. 6, 485-490(Dec 1973).

Radiative capture of a thermal neutron by the central cobalt atom of vitamin B_{12} molecules leads to breakdown of the structure, approximately 90% of the resulting radioactive cobalt appearing as cobaltous ion. The small fraction of ^{60}Co activity which is retained in the form of organocobalt compounds is distributed between three species, hydroxocobalamin, cyanocobalamin and a red-brown material of unknown structure. The latter compound is also produced when vitamin B_{12} is exposed to γ radiation and is believed to result from hydroxyl radical attack. The activity retention values in the various species appear to be substantially independent of post neutron-irradiation exposure to ionizing radiation, heat treatment or mechanical crushing. The presence of radical scavenging solutes during the post neutron-irradiation dissolution stage also has little effect except in the case of 2-methyl propan-2-ol. This very effective hydroxyl radical scavenger has the unexpected result of increasing the proportion of activity in the brown compound resulting from hydroxyl radical attack. (auth)

12573 ELECTRON PARAMAGNETIC RESONANCE AND OPTICAL ABSORPTION STUDIES OF RADIATION-INDUCED RADICALS IN NAPHTHALENE SINGLE CRYSTALS. Chong, T.; Itoh, N. (Nagoya Univ., Japan). J. Phys. Soc. Jap.; 35: No. 2, 518-524(Aug 1973).

Optical absorption and electron paramagnetic resonance (EPR) of naphthalene single crystals irradiated with x-rays or electrons at liquid nitrogen temperature were studied. The vibronic structures of the optical absorption bands at 539, 632, and 710 nm were analyzed. It is shown that each of the species associated with these absorption bands has another transition in the visible or ultraviolet region, and it is concluded that they are cyclohexadienyl-type radicals. The change of the EPR spectrum at room temperature of a specimen irradiated at liquid nitrogen temperature was analyzed and it was found that the broad EPR doublet, ascribed to the naphthyl radical, decays according to the first-order reaction kinetics with the time constant of 11 hr at room temperature. (auth)

12574 ENERGY OF THE QUASI-FREE ELECTRONS AND THE PROBABILITY OF ELECTRON LOCALIZATION IN LIQUID HYDROCARBONS. Schiller, R.; Vass, S.; Mandics, J. (Central Research Inst. for Physics, Budapest). Int. J. Radiat. Phys. Chem.; 5: No. 6, 491-503(Dec 1973).

Work was carried out to obtain a better understanding of the nature of the negative charge carriers produced in liquid hydrocarbons by ionizing radiation or by electron injection. Quasi-free electron energies in the five aliphatic hexane isomers, benzene, and toluene were measured by a photo-electron injection technique and, with the sole exception of n-hexane, were found to be negative. These results were shown to be consistent with the idea of electrons localized in bubbles if polarization in the localized state was accounted for. To explain the variation in electron mobilities from liquid to liquid, an unlimited energy exchange was assumed between localized electrons and their surroundings, which means that energy fluctuations influence the state of the electrons. With this assumption, both mobilities and activation energies could be adequately described for open-chain hydrocarbons, but cyclic compounds seemed to disobey the quantitative predictions. (auth)

12575 ESR OF γ-IRRADIATED POTASSIUM PERSULFATE ENRICHED IN ^{17}OXYGEN AND ^{33}SULFUR. Reuveni, A. (Weizmann Inst. of Science, Rehovoth, Israel); Luz, Z.; Silver, B. L. J. Magn. Resonance; 12: No. 2, 109-118(Nov 1973).

Electron spin resonance measurements of γ-irradiated single crystals of isotopically enriched ^{33}S- and ^{17}O-$K_2S_2O_8$ at Q-band frequency are reported. Two types of radicals, A and B, previously identified as SO_4^- and $S_2O_8^-$, were studied. No interaction with ^{33}S was detected in either radical, but both showed hyperfine splitting due to ^{17}O nuclei. Analysis of these splittings for radical B is consistent with the previous assignment, if it is assumed that the unpaired electron resides only on two symmetry related oxygen atoms. In radical A, the unpaired electron is confined to the two peroxyl oxygens with a ratio of ~ 2 : 1. The magnetic parameters for both radicals were found to be temperature dependent. "Forbidden transitions" were observed in the spectra of radical B at orientations where the ^{17}O hyperfine interaction is comparable to its Zeeman interaction. An analysis of these transitions is presented. (auth)

12576 FREE RADICALS IN PYRIMIDINES. ESR of X-irradiated Single Crystals of Phenobarbital. Gutierrez, P. (Southern Illinois Univ., Carbondale); Lorenz, P.; Benson, B. Int. J. Radiat. Biol.; 24: No. 4, 427-431(Oct 1973).

Two crystal polymorphs of phenobarbital, of melting points 175°C and 173°C, were x-irradiated in air at room temperature with doses of 10 Mrads. ESR spectra were recorded at 5° intervals about each of 3 orthogonal axes at both 9.3 GHz and 22.5 GHz. A comparative table is presented of the ESR data obtained from the two crystal structures. The results were essentially the same, except that the relative values of the proton hyperfine couplings were different because of the different ethyl group rotations about the bond to C(5). It is tentatively suggested that one factor important to the mechanism of radical formation in this group of compounds is the difficulty in reorienting a large group into the plane of the pyrimidine ring when the electronic configuration of C(5) goes from sp^3 in the undamaged molecule, to sp^2 in the free radical. It is also suggested that another factor to be considered is the relative stability of alternate radical structures. (UK)

12577 INERT GAS-SENSITIZED RADIOLYSIS OF METHYL MERCAPTAN. Lind, J.; Bjelljqvist, B.; Eriksen, T. E. (Royal Inst. of Tech., Stockholm). Int. J. Radiat. Phys. Chem.; 5: No. 6, 479-484(Dec 1973).

γ radiolysis of dilute gaseous mixtures of CH_3SH with argon and nitrogen was carried out. G-values for mercaptan depletion and product formation are reported. The results are explained in terms of charge transfer, energy transfer, and radical reactions. (auth)

12578 INFLUENCE OF DOSE RATE ON THE FORMATION OF RADIATION-INDUCED DEFECTS IN IONIC CRYSTALS. Gromov, V. V.; Karaseva, L. G. (Inst. of PhysicalChemistry, Moscow). Int. J. Radiat. Phys. Chem.; 5: No. 6, 457-461(Dec 1973). (In Russian).

The ratio of the concentrations of the radicals SO_4^- and SO_3^- formed under γ-irradiation (at room temperature) in strontium sulfate is shown to decrease with increasing dose rate. For example, $c_{SO_4^-}/c_{SO_3^-} = 2.9$ (for an absorbed dose of 2.10^6 rads, with a dose rate of 1 rad/s); this ratio decreases to 2.1 at the same absorbed dose but at a dose rate equal to 10^3 rad/s. Simultaneously, at a low dose rate the total concentration of the paramagnetic centers rises by 25 to 30% (for the same absorbed dose). The results obtained are explained by supposing that at a high dose rate higher concentrations of "hot spots" are formed in the crystal lattice. At these "hot spots" the processes of radical recombination are accelerated and therefore the concentration of radicals is reduced. (auth)

12579 INVESTIGATION OF LOW-TEMPERATURE RADIOLYSIS OF SODIUM HYPOPHOSPHITE BY THE EPR METHOD. Nanobashvili, E. M.; Tushurashvili, R. G.; Khomasuridze, Zh. F. (Inst. of Inorganic Chemistry and Electronics, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 71: No. 3, 621-624(Sep 1973). (In Russian).

Low-temperature radiolysis of polycrystals of sodium hypophosphite and its aqueous solutions at various concentration was investigated. The primary products of radiolysis were found to be OH, H_2PO_2 radicals, ion radicals HPO_2^-, and trapped electrons. The yields of the radicals were determined and the mechanism of their formation suggested. (auth)

12580 MOLAR EXTINCTION COEFFICIENT OF THE SOLVATED ELECTRON AND THE G(FREE ION) YIELD IN LIQUID METHANOL. Busi, F.; Ward, M. D. (Consiglio Nazionale delle Richerche, Bologna). Int. J. Radiat. Phys. Chem.; 5: No. 6, 521-523(Dec 1973).

The G (free ion) yield and the molar extinction coefficient of the solvated electron have been determined in methanol by simultaneous conductometric and optical pulse radiolysis. (auth)

12581 PULSE RADIOLYTIC INVESTIGATIONS ON THE DEPENDENCE OF CHAIN LENGTH ON REACTIONS OF WATER SOLUBLE OLIGOMERS AND POLYMERS. Behzadi, A. Berlin; Technische Univ., Berlin (1972). 61p. (In German).

Thesis.

The dependence of the rate constants of the reactions of the OH radical with polyethylene oxide, polyvinyl pyrrolidone, dextran, and Na-polyacrylate on the chain length and concentration of the polymers has been measured. The OH-radical exhibits a practically diffusion-controlled reaction with these polymers. The diffusion measurements were carried out according to the diaphragm method; the bimolecular reaction constants were determined by means of pulse radiolysis using optical absorption measurements. (HK/LH) (GE)

12582 RADIOLYSIS OF ACETIC ACID IN AQUEOUS SOLUTIONS AND ACETIC ACID-WATER MIXTURES. Josimovic, L.; Draganic, I. (Boris Kidric Inst. of Nuclear Science, Belgrade). Int. J. Radiat. Phys. Chem.; 5: No. 6, 505-512(Dec 1973).

The radiation chemical yields of stable products were measured in deaerated and oxygenated solutions at low absorbed doses (≤ 10 krad), different pH values (1 to 3 and 7.8) and various acetic acid concentrations (0.1 to 17 mol dm^{-3}). For a dilute solution (0.1 mol dm^{-3}) the results obtained support a simple reaction scheme. At larger acetic acid concentrations, yields of stable products change proportionally to the electron fraction of acetic acid in irradiated mixture. Determinations of molecular hydrogen in deaerated solutions and some measurements of nitrite ion yield in the presence of nitrate point to the reaction of acetic acid with the precursor of the hydrated electron. Optical absorption spectra of intermediates in deaerated acetic acid-water mixtures were obtained by pulse radiolysis. (auth)

12583 STUDIES ON THE EFFECTS OF GAMMA RADIATION ON 6-AMINOPENICILLANIC ACID AND ITS DERIVATIVES BY THE EPR METHOD. Dziegielewski, J.; Jezowska-Trzebiatowska, B.; Kozlowski, H. (Univ., Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Chim.; 21: No. 7-8, 605-609(1973).

Commercial samples of 6-aminopenicillanic acid (6-APA), potassium benzyl-penicillin, procaine benzyl-penicillin, procaine hydrochlorides and sodium 3-(o-chlorophenyl)-5-methyl-4-isoxasol penicillin salt were irradiated with 0.5 to 40 Mrad and examined by the EPR method within the temperature range 100 to 300°K. No influence of the irradiation dose on powder EPR spectra structure has been stated, except for benzyl-penicillin procaine. In irradiated samples of antibiotics the presence of radicals with unpaired electrons on sulfur atoms and carbon atoms abutting on the thioether group has been stated. (auth)

12584 NEW MORPHOLOGY OF POLYETHYLENE PREPARED BY γ-RAY-INDUCED POLYMERIZATION. Arai, H.; Wada, T.; Kuriyama, I. (Japan Atomic Energy Research Inst., Takasaki). J. Polym. Sci., Polym. Phys. Ed.; 11: No. 11, 2297-2301(Nov 1973).

The γ-ray-induced polymerization of ethylene was carried out in the presence of mica plates with cleavage surfaces covered by evaporated carbon. By using this method of polymerization, the effect of solvents exhibiting various affinities toward polyethylene on the morphology of the nascent polymer can be studied. Polymerization of ethylene in cyclohexane produced large platelet crystals composed of folded chains, while polymerization in bulk and in methanol gave small granular particles and complex aggregates. (LK)

12585 INFRARED SPECTRAL IMPURITY ENHANCEMENT IN A RADIATED SAMPLE. Ansari, B. J.; Chakravorty, A. K. (Fertilizer Corp. of India Ltd., Sindri). Technology (Sindri); 9: No. 4, 394-395(1972).

Exposure of pyridinium dipicrylaminate to ^{60}Co γ radiation causes dissociation into pyridine and dipicrylaminate. The spectra showed bands of the parent compound, its dissociated constituents, and two new bands. The new band at 1379 cm^{-1} appears to be associated with asymmetric stretching of $[NO_2]^-$ ion. It is believed that this ion is embodied in pyridinium dipicrylaminate and that irradiation frees the $[NO_2]^-$ ion to give significant infrared band. (LK)

12586 EFFECT OF GAMMA RADIATION ON SELF-DIFFUSION OF IONIC AND COLLOIDAL FORMS OF RADIONUCLIDES. Kepak, F.; Kriva, J. (Ustav Jaderneho Vyzkumu, Rez, Czech.). J. Inorg. Nucl. Chem.; 36: No. 1, 220-222(Jan 1974).

A report is presented on the effects of gamma radiation on the self-diffusion of ions and colloidal forms of radionuclides in extremely low concentrations in aqueous solutions. In previously published work a capillary with an open end was used, but owing to the difficulties arising from the application of this method to samples of high specific radioactivity, in the experiments now reported external irradiation by ^{60}Co gamma radiation was used. Under these conditions, the coefficient of self-diffusion of ^{106}Ru(IV), $^{106}RuNO$(III), ^{144}Ce(III), ^{147}Pm(III), ^{54}Mn(IV), ^{85}Sr(II) and $^{131}I^-$ was determined when they were present in the solution both as ions and, with the exception of Sr(II), as colloidal hydroxides or as a sol of silver iodide. (UK)

12587 EFFECT OF IONIZING RADIATION ON THE REACTIVITY OF ε-AMINO GROUPS IN TROPOCOLLAGEN. Jelenska, M. M.; Dancewicz, A. M. (Inst. of Nuclear Research, Warsaw). Acta Biochim. Pol.; 19: No. 4, 341-346(1972).

After x irradiation of tropocollagen solution in the presence of nitrogen with 30 kilorad, the content of free ε-amino groups decreased from 36 to 26 per α-chain. This decrease was but apparent and resulted from conformational changes in tropocollagen (formation of new interchain cross-linking bonds) that block the access of fluorodinitrobenzene to some of free ε-amino groups. (auth)

12588 SENSE OF CLEAVAGE OF SUBSTITUTED BENZENES ON REACTION WITH SOLVATED ELECTRONS, AS DETERMINED BY A PRODUCT CRITERION. Rossi, R. A.; Bunnett, J. F. (Univ. of California, Santa Cruz). J. Amer. Chem. Soc.; 96: No. 1, 112-117(9 Jan 1974).

Many compounds of type C_6H_5X, in which the first atom of substituent X represents diverse elements, are cleaved by potassium metal in ammonia. It is possible to tell whether the immediate fragment from cleavage is phenyl radical or phenyl anion by conducting cleavage in the presence of acetone enolate ion. Phenyl radical is trapped by the enolate ion, as recognized by the formation of phenylacetone, 1,1-diphenyl-2-propanone, and/or 1-phenyl-2-propanol, often in high total yield. Phenyl anion does not arylate the enolate ion, and merely takes a proton from the solvent to appear as benzene. The sense of scission of compounds of the type PhY, Ph_2Y, or Ph_3Y, where Y is an element of group VII, VI, or V, correlates with the electronegativities of the elements. Phenyl radical is formed when Y is F, Cl, Br, I, O, or

S, and phenyl anion when Y is P, As, Sb, or Bi, and both competitively when Y is Se. Ph_2I^+, $PhNMe_3^+$, $(PhO)_3PO$, and $PhOPO(OEt)_2$ also cleave to phenyl radical, while Ph_2SO, Ph_2SO_2, $PhSO_2Me$, and $PhSO_2^-$ are cleaved to phenyl anion. Cleavage of Ph_3S^+ is complex. Some compounds are unaffected, or cleave in other ways. (auth)

12589 FENTON'S REAGENT. IV. Structure and Reactivity Relations in the Reactions of Hydroxyl Radicals and the Redox Reactions of Radicals. Walling, C.; El-Taliawi, G. M.; Johnson, R. A. (Univ. of Utah, Salt Lake City). J. Amer. Chem. Soc.; 96: No. 1, 133-139(9 Jan 1974).

Reactivities of a variety of alcohols, ethers, and amides toward hydroxyl radicals have been examined. Results are in encouraging agreement with radiation chemistry results. Reactivities of different C–H bonds have been dissected from the data and indicate that the hydroxyl radical is a strongly electrophilic species, so that electron supply is more important than C–H bond strength in determining reactivity. Comparison with gas-phase data shows similar reactivity patterns, but considerably faster reactions in H_2O. Radicals α to –OH, –OR, and amide N are readily oxidized by Fe^{3+}; tert-alkyl radicals are oxidized with more difficulty and allyl radicals hardly at all. In contrast, radicals $R\dot{C}(OH)CCl_3$ are reduced by Fe^{2+}. Results are consistent with a fast oxidation of easily oxidized radicals by Fe^{3+} via electron transfer, and a slower more general oxidation of radicals by Cu^{2+} via a RCu(III) intermediate. (auth)

12590 KINETICS OF AMMONIA DETACHMENT FROM REDUCED COBALT(III) COMPLEXES BASED ON CONDUCTOMETRIC PULSE RADIOLYSIS. Simic, M. (Univ. of Texas, Austin); Lillie, J. J. Amer. Chem. Soc.; 96: No. 1, 291-292(9 Jan 1974).

Kinetics of ammonia detachment from a rapidly reduced cobalt(III)hexamine and some $Co^{III}(NH_3)_5X$ complexes were studied. Research potential of a recently developed alternating current kinetic conductivity technique coupled to pulse radiolysis in the study of coordination complexes is reported. (LK)

12591 ELECTRON SPIN RESONANCE DETERMINATION OF EFFICIENCY OF FREE RADICAL PRODUCTION IN BIOLOGICAL MEMBRANES BY VARIOUS TYPES OF IONIZING RADIATION. Fisher, H. L. Jr. Atlanta; Georgia Inst. of Tech. (1973). 183p. University Microfilms Order No. 73-29,006.

Thesis (Ph. D.).

Radiation damage to the plasma membrane, a component necessary for cellular existence, was studied by observing free radicals produced by radiation of different qualities. Membranes were separated from hemolysed red blood cells and exposed to gamma, neutron, alpha, and fission product radiations. Exposures and measurements were made at both 77°K and room temperature. Free radical measurements were made with an electron spin resonance spectrometer operating at about nine GHz and equipped with an analog to frequency converter, permitting storage of the spectrum in a 400-channel scaler. The digitalized spectrum was subsequently analyzed with a computer where background and baseline corrections could be made. Free radical yields in lyophilized membranes varied inversely as the LET of the radiation. At room temperature the initial yield for gamma radiation was five radicals/100 eV while for alpha radiation the yield was 0.6 and for fission product radiation the yield was 0.03. The build-up of radicals was generally linear with dose although radical saturation was apparent in a few samples. At 77°K hydrogen radicals were observed in samples exposed to gamma rays but not to high LET radiation. However, the yield was quite low, being about 0.001 radical/100 eV. The g-values for free radicals produced by radiation were close to that of the free electron. Membrane samples containing water exposed to gamma rays exhibited larger g-value shifts than dry samples. Large shifts were also observed for dry samples exposed to high LET radiation at 77°K and annealed at room temperature. From the ESR spectra it was concluded that the radicals observed at room temperature are not the primary radicals produced by the radiation. Radical reactions were also observed to continue over a period of hours or days. Since the yield of free radicals in membrane material is sufficiently high, radicals are likely involved in producing membrane damage. The exact pathway by which this occurs remains to be explored. (Diss. Abstr. Int., B)

12592 UNSTABLE INTERMEDIATES. Pt. 135. The Formation of Sn^{3+} and Pb^{3+} Centres in Irradiated Tin and Lead Salts, and Their Electron Spin Resonance Parameters. Booth, R. J.; Starkie, H. C.; Symons, M. C. R.; Eachus, R. S. (Univ. of Leicester, Eng.). J. Chem. Soc., Dalton Trans.; No. 21, 2233-2236(1973).

A wide range of stannous, stannic, plumbous, and plumbic compounds were exposed to ^{60}Co γ rays at 77°K and their ESR spectra studied. In most cases very high-field features were detected that can be ascribed to species containing ^{119}Sn, ^{117}Sn, and ^{207}Pb nuclei. These are thought to be Sn^{3+} and Pb^{3+} ions bonded to various ligands characteristic of the host lattices. Trends in the derived hyperfine coupling constants are discussed in terms of environmental effects. (auth)

12593 POSSIBLE FORMATION OF SINGLET OXYGEN IN THE RADIOLYSIS OF WATER UNDER HIGH-PRESSURE OXYGEN. Alkaitis, S. A.; Libby, W. F. (Univ. of California, Los Angeles). Nature (London) Phys. Sci.; 244: No. 139, 143(27 Aug 1973).

It is stated that although the room temperature radiolysis of oxygenated aqueous solutions from zero pressure up to a saturating oxygen pressure of 1 atm has been well studied, few studies at pressures > 1 atm have been reported. Due to its high affinity for the reducing radicals atomic H and e^-_{aq} the presence of oxygen in aqueous solutions will convert these radiolytically produced radicals to HO_2 and O_2^-. In irradiated solutions therefore the presence of oxygen is expected to interfere with radical recombination reactions, such as $H + H \rightarrow H_2$ and $H + OH \rightarrow H_2O$, and the increase in overall radical yields with increasing oxygen concentration has been generally attributed to such processes. Experimental data are presented, however, to indicate that this explanation may be insufficient. A determination was made of the dependence of $G(Fe^{3+})$ and $G(Ce^{3+})$ on oxygen concentration, up to P_{O_2} = 118 atm, in the ^{60}Co γ radiolysis of aqueous 0.8 N H_2SO_4 solutions containing Fe^{2+} and Ce^{4+} ions, and an interpretation of the results is given involving singlet oxygen, $O_2(^1D_g)$. (UK)

12594 SEPARATION OF TRIBUTYL PHOSPHATE AND ITS RADIOLYSIS PRODUCTS BY THIN-LAYER CHROMATOGRAPHY. Rochon, A. M. (Inst. for Nuclear Research, Warsaw). Chem. Anal. (Warsaw); 18: No. 5, 1077-1079(1973). (In Polish).

Thin-layer chromatography who used to separate the radiolysis products of TBP (e.g., Purex process solvent) from the TBP itself. The H_3PO_4, H_2MBP, and HDBP were readily identified by white spots, with TBP giving a red spot. The method is readily adapted to ^{32}P tracing. (TTT)

12595 RADIOLYSIS OF PHOSPHATE CATION EXCHANGERS OF THE KFE TYPE. Kott, V. N.; Semushin, A. M.; Kuzin, I. A.; Kuznetsova, N. N.; Papukova, K. P. (Leningrad Technological Inst.). J. Appl. Chem. USSR (Engl. Transl.); 46: No. 7, 1558-1561(Jul 1973).

Translated from Zh. Prikl. Khim.; 46: No. 7, 1458-1462(Jul 1973).

Study of the action of ^{60}Co γ radiation on three specimens of KFE resins with doses up to $6 \cdot 10^8$ rad showed that the radiation resistance of the cation exchangers increases sharply with increase of the cross-link content and as the result of conversion from the salt into the hydrogen form. The main water-soluble products formed by breakdown of the resins are orthophosphate ions and fragments of poly-β-phenoxyethylphosphonic acid chains; the gaseous products consist mainly of hydrogen. The yields of these radiolysis products depend on the radiation dose, the degree of cross-linking of the resin, and the irradiation conditions. On the basis of the experimental data an empirical coefficient characterizing resin stability is proposed, and a scheme representing radiolysis of the resins is put forward. (auth)

12596 SYNTHESIS OF SULFONATED CATION-EXCHANGE MEMBRANES BASED ON ACENAPHTHYLENE AND POLYETHYLENE, AND STUDY OF THE INFLUENCE OF IRRADIATION AND HEATING ON THEIR PROPERTIES. Tulupov, P. E.; Greben, V. P.; Mezentsev, A. I.; Zagorskaya, Z. G.; Tikhomirova, N. S.; Nefedova, G. Z. J. Appl. Chem. USSR (Engl. Transl.); 46: No. 7, 1562-1566(Jul 1973).

Translated from Zh. Prikl. Khim.; 46: No. 7, 1462-1467(Jul 1973).

The radiation and thermal stability of RMK-101p membrane subjected to irradiation in a ^{60}Co γ-ray source was studied. The membrane was synthesized by grafting acenaphthylene from a continuously stirred saturated solution in aqueous acetone onto powdered high-pressure polyethylene of particle size 0.25–0.5 mm. RMK-101p membrane was heated in water at 75, 100, 120, and 150°C, in 3N HNO_3 at 50 and 75°C, and in 3N HCl and 3N KOH at 75°C. The results of these studies showed that for heat-resistant ion-exchange materials styrene copolymers are preferable to acenaphthylene copolymers. (LK)

12597 MECHANISM OF THE γ RADIOLYSIS OF WATER IN THE PRESENCE OF H_2O_2, H_2, O_2. Maiboroda, V. D.; Petryaev, E. P.; Byakov, V. M. (Belorussian State Univ., Minsk). Vestsi Akad. Navuk Belarus. SSR, Ser. Fiz.-Energ. Navuk; No. 1, 32-36(1973). (In Russian).

Allen's mechanism of water radiolysis is not inconsistent with experimental data obtained under γ-radiolysis of water in the presence of H_2O_2, H_2, O_2. Introduction of the new exciton mechanism of water radiolysis by Shubin and Kabakchy for the description of experimental data is not sufficiently justified because the monomolecular reaction ext → H_2O for which the mechanism is introduced, doesn't play a sufficient role in the description of experimental data. (auth)

12598 GRAFT COPOLYMERIZATION OF STYRENE TO PREIRRADIATED POLYMETHYLENE FROM CARBON MONOXIDE AND HYDROGEN. Pichler, H.; Bellstedt, F. (Univ., Karlsruhe, Ger.). J. Polymer Sci., Polym. Chem. Ed.; 11: No. 11, 3025-3028(Nov 1973).

Irradiated polymethylene (from CO and H_2) is a very effective radical-trapping material for graft copolymerization. Compared with high-density polyethylene, polymethylene yields higher amounts of grafted styrene. This effect is similar to the greater crosslinking efficiency of the polymethylene. (auth)

12599 AGING AND DEGRADATION OF POLYOLEFINS. III. Polyethylene and Ethylene–Propylene Copolymers. Decker, C.; Mayo, F. R.; Richardson, H. (Stanford Research Inst., Menlo Park, CA). J. Polymer Sci., Polym. Chem. Ed.; 11: No. 11, 2879-2898(Nov 1973).

Rates of oxygen absorption and formation of oxidation products were determined in γ-initiated oxidations of thin films of high- and low-density polyethylene, atactic and isotactic polypropylene, and of three ethylene–propylene copolymers. Radiation yields G for O_2 absorbed and formation of hydroperoxides depend on dose rates and decrease sharply with increasing ethylene content of the copolymers and moderately with increasing crystallinity of any base polymer. G values for dialkyl peroxide and carbonyl formation, and therefore for chain initiation and termination, do not change much with polymer composition and crystallinity and not at all with dose rates. A few experiments with atactic polypropylene and an amorphous ethylene–propylene copolymer, initiated by di-tert-butylperoxy oxalate, indicate that 37 mole % of ethylene in the polymer increases the efficiency of initiation and the tendency toward crosslinking. (auth)

12600 RADIATION-INDUCED POLYMERIZATION OF GLASS-FORMING SYSTEMS. IV. Effect of the Homogeneity of Polymerization Phase and Polymer Concentration on Temperature Dependence of Initial Polymerization Rate. Kaetsu, I.; Ito, A.; Hayashi, K. (Japan Atomic Energy Research Inst., Takasaki). J. Polymer Sci., Polym. Chem. Ed.; 11: No. 6, 1141-1147(Jun 1973).

The effect of homogeneity of polymerization phase and monomer concentration on the temperature dependence of initial polymerization rate was studied in the radiation-induced radical polymerization of binary systems consisting of glass-forming monomer and solvent. In the polymerization of a completely homogeneous system such as HEMA-propylene glycol, a maximum and a minimum in polymerization rates as a function of temperature, characteristic of the polymerization in glass-forming systems, were observed for all monomer concentrations. However, in the heterogeneous polymerization systems such as HEMA-triacetin and HEMA-isoamyl acetate, maximum and minimum rates were observed in monomer-rich compositions but not at low monomer concentrations. Furthermore, in the HEMA-dioctyl phthalate polymerization system, which is extremely heterogeneous, no maximum and minimum rates were observed at any monomer concentration. The effect of conversion on the temperature dependence of polymerization rate in homogeneous bulk polymerization of HEMA and GMA was investigated. Maximum and minimum rates were observed clearly in conversions less than 10% in the case of HEMA and less than 50% in the case of GMA, but the maximum and minimum changed to a mere inflection in the curve at higher conversions. A similar effect of polymer concentration on the temperature dependence of polymerization rate in the GMA-poly(methyl methacrylate) system was also observed. It is deduced that the change in temperature dependence of polymerization rate is attributed to the decrease in contribution of mutual termination reaction of growing chain radicals to the polymerization rate. (auth)

12601 RADIATION-INDUCED POLYMERIZATION OF GLASS-FORMING SYSTEMS. V. Initial Polymerization Rate in Binary Glass-Forming Systems. Kaetsu, I.; Okubo, H.; Ito, A.; Hayashi, K. (Japan Atomic Energy Research Inst., Takasaki). J. Polymer Sci., Polym. Chem. Ed.; 11: No. 6, 1149-1156(Jun 1973).

The radiation-induced polymerization of binary systems consisting of glass-forming monomer and glass-forming solvent in supercooled phase was studied. The initial polymerization rates were markedly affected by T_g (glass transition temperature) and T_v of the system (30–50°C higher than T_g), which are functions of the composition. The composition and temperature dependence of initial polymerization rate in binary glass-forming systems were much affected by homogeneity of the polymerization system and the T_g of the glass-forming solvent. The composition and temperature dependences in the glycidyl methacrylate–triacetin system as a typical homogeneous polymerization system were studied in detail, and the polymerizations of hydroxyethyl methacrylate–triacetin and hydroxyethyl methacrylate–isoamyl acetate systems were studied for the heterogeneous polymerization systems; the former illustrates the combination of lower T_g monomer and higher T_g solvent and the latter typifies a system consisting of higher T_g monomer and lower T_g solvent. All experimental results for the composition and temperature dependence of initial polymerization rate in binary glass-forming systems could be explained by considering the product of the effect of the physical effect relating to T_v and T_g of the system and the effect of composition in normal solution polymerization at higher temperature, which was also the product of a dilution effect and a chemical or physical acceleration effect. (auth)

12602 COMPARISON OF PHOTO- AND RADIATION-INDUCED RADICAL FORMATION IN POLYETHYLENE BY ESR SPECTROSCOPY. Tsuji, K. (Sumitomo Chemical Co., Ltd., Osaka). J. Polymer Sci., Polym. Chem. Ed.; 11: No. 6, 1407-1419(Jun 1973).

The behaviors of free radicals produced in polyethylene irradiated with ultraviolet light and electron beams were compared in connection with primary processes of radical formation and trapping regions of free radicals. In the case of irradiation with ultraviolet light, an ESR spectrum observed at −196°C immediately after irradiation is an eight-line spectrum due to alkyl radicals of the type $-CH_2-\dot{C}H-CH_3$, while in the case of ionizing radiation, a six-line spectrum due to $-CH_2-\dot{C}H-CH_2-$ was observed. The former radicals are produced by the Norrish type I reaction of the carbonyl groups contained in the polymer, followed by radical rearrangement; and the latter are formed by dissociation of hydrogen atom from the excited state of the polymer of ion-molecular reactions. From the sensitivity to oxygen molecules, it was deduced that free radicals are trapped in amorphous regions after ultraviolet irradiation, but mainly in crystalline regions after irradiation with electron beams. Saturation studies of ESR spectra seem to support this conclusion. (auth)

12603 SYNTHESIS AND INVESTIGATION OF PROPERTIES OF POLYACRYLONITRILE CONTAINING PRIMARY GROUPS. Ryasnoi, V. D.; Arkhiptsev, V. M.; Salamatov, I. I. (Inst. of Nuclear Energy, Minsk). Vestsi Akad. Navuk Belarus. SSR, Ser. Fiz.-Energ. Navuk; No. 1, 13-18(1972). (In Russian).

In the polymerization of acrylonitrile, polyethylenepolyamine is introduced. It regulates the molecular weight of the polymer during the radiation chemical initiation of the polymerization with ^{60}Co γ rays or acts as a component of the initiating system together with potassium persulfate. The viscosity of the polymer decreases independently of the type of initiator with increase of the amine concentration in the medium, but the concentration of primary groups increases. The yield, polymer viscosity, and concentration of primary groups depend on the polymerization conditions: pH of the medium, duration of synthesis, and type of initiator. Polyethylenepolyamine, introduced into the polymer structure, does not affect the phase state of the polymer. In the comparison of two methods of preparation of polyacrylonitrile with primary groups the best results were obtained by radiation chemical initiation of the acrylonitrile polymerization with ^{60}Co γ rays. (tr-auth)

12604 STUDY BY THE RADIOTHERMOLUMINESCENCE METHOD OF LOW-TEMPERATURE MOLECULAR MOTION PROCESS IN THREE-DIMENSIONAL POLYMERS OF OLIGOESTER ACRYLATES. Gulyavtsev, V. N.; Sivergin, Yu. M.; Zelenev, Yu. V.; Berlin, A. A. (Moscow State Pedagogical Inst.). Vysokomol. Soedin., Ser. A; 15: No. 10, 2288-2295(Oct 1973). (In Russian).

Molecular motion was investigated in grid polymers of oligoester acrylates. The process depends on the length and chemical structure of the oligo-dimensional unit and on the nature of the principal chain. Correlation of radiothermoluminescence and NMR data methods was observed. Values of the activation energy of the individual processes of molecular motion were calculated. Possible evaluation of the parameters of the time relaxation distribution from the data of the radiothermoluminescence method is shown. (tr-auth)

12605 RADIOINDUCED IONIC GRAFT POLYMERIZATION OF VINYL n-BUTYL ETHER. Kabanov, V. Ya.; Sidorova, L. P. Vysokomol. Soedin., Ser. B; 15: No. 9, 644(Sep 1973). (In Russian).

It was shown that the radiation grafting of vinyl n-butyl ether to polyethylene can be accomplished with satisfactory yield after preliminary desiccation of the monomer with KSM 6P silica gel. (JSR)

Radiochemistry and Nuclear Chemistry

Refer also to abstract 12960.

12606 (BARC-690, pp 49-50) ANALYTICAL SERVICES. 1973.

An abstract was prepared for each section of the report. (DHM)

For abstracts of individual sections see: 12500-12503, 12516-12518, 12537-12539, 12555, 12556, 12613-12615, 12642, 12647, 12648, 12759, 12760, 12960, and 14271.

12607 (N-73-24156) SURVEY OF APPLICATION OF RADIATION TO PREPARATIVE CHEMISTRY. Phillipp, W. H. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). May 1973. 34p. (NASA-TN-D-7285; E-7264). NTIS $3.00.

The use of radiation for preparative chemistry in liquid solutions was investigated. General principles are presented and preparations involving reduction, oxidation, polymerization, and decomposition are given. The use of various solvents, water, other inorganic liquids, and organic liquids for this purpose is discussed. Finally, a commentary is made on some specific applications where radiation chemistry as a preparative technique may be useful. (auth)

Hot-Atom Chemistry

Refer also to abstracts 12568, 12572, and 14271.

Properties of Radioactive Materials

Refer also to abstracts 12543, 12544, 12692, 12999, and 13165.

12608 (ANL-7996) CHEMISTRY DIVISION ANNUAL REPORT, JULY 1971-JUNE 1972. (Argonne National Lab., Ill. (USA)). Feb 1973. Contract W-31-109-eng-38. 177p. Dep. NTIS $7.60.

The 20 sections of this progress report have been abstracted individually for NSA. (JGB)

For abstracts of individual sections see: 12528, 12536, 12553, 12554, 12609-12612, 12959, 13165, 13281, 13677, 13723, 14013, 14269, 14270, 14427, and 15097-15099.

12609 (ANL-7996, pp 1-7) HEAVY-ELEMENT CHEMISTRY. Feb 1973.

In chemistry division annual report, July 1971-June 1972.

Progress in phase studies on various oxides and hydroxides of uranium is reported. A current hydrothermal study of rare earth-uranium oxide systems at 200 to 360°C has led to the identification of nine structure types, two of which represent anhydrous oxides. None of the phases is common to all rare earth elements. A marked increase in the tendency to form hydrated double oxides was observed with an increase in rare earth ion radius from Lu to La. Pu(IV) was oxidized to Pu(VI) in a KOH-NaOH eutectic. The solution absorption spectra of Bk^{3+}, Cf^{3+}, and Es^{3+} are given. In studies on the co-ordination chemistry of Cf^{3+}, evidence for the stability of $CfCl_3$ against reduction to $CfCl_2$ by hydrogen was obtained. Preliminary results of studies on the sorption of Pu by limestone, shale, and sandstone indicate that the distribution coefficient of Pu in the various sedimentary rock/neutral aqueous phase systems is extremely high. A list of published research is included. (JGB)

12610 (ANL-7996, pp 108-117) INORGANIC CHEMISTRY. Feb 1973.

In chemistry division annual report, July 1971-June 1972.

Studies on the preparation and properties of noble gas compounds are reported. The enthalpies of formation and average bond dissociation enthalpies of XeF_6, XeF_4, and XeF_2 are given. Results of studies on the removal of Rn and Xe isotopes from air using O_2SbF_6 and the removal of radon isotopes from ambient air using BrF_3 are tabulated. Physical parameters of HF, including vapor pressure and boiling point, liquid density, and vapor density at several temperatures were determined. From the intensity of the rotational Raman bands of the monomer, a direct measurement of the monomer concentration as a function of total pressure at several temperatures was made. Microwave and ir spectral studies on DOF and HOF are summarized. (JGB)

12611 (ANL-7996, pp 122-131) STRUCTURAL CHEMISTRY. Feb 1973.

In chemistry division annual report, July 1971-June 1972.

Results of several x-ray crystallographic studies are reported, including structural parameters of KrF_2, XeO_2F_2, and γ-$UO_3(OH)_2$. The four-circle diffractometer installation, now being used in neutron crystallography studies, is described. Results of neutron-diffraction studies on the H_3O^+ (oxonium) ion in p-toluenesulfonic acid monohydrate are summarized. Results of magnetic structure analyses of Er, ErC_2, $ErAu_2$, $ErAg_2$, and $HoAu_2$, which have been published elsewhere, are also summarized. (JGB)

12612 (ANL-7996, pp 136-142) ATOMIC SPECTROSCOPY. Feb 1973.

In chemistry division annual report, July 1971-June 1972.

Preliminary results on measurements of the absorption spectra of $BkCl_3$ and $CfCl_3$ are reported. Progress in other studies on the emission and absorption spectroscopy some of the actinide elements and their compounds is summarized. (JGB)

12613 (BARC-690, pp 60-62) PREPARATION OF PLUTONIUM TETRAFLUORIDE. Iyer, P. N.; Vaidya, V. N.; Prasad, R.; Venugopal, V.; Roy, K. N.; Venkataramana, P.; Singh, Z.; Laxminarayanan, T. S. 1973.

A method is reported for the preparation of PuF_4 by the hydrofluorination of PuO_2 at 500°C. (DHM)

12614 (BARC-690, pp 69-93) SOLUTION CHEMISTRY. 1973.

Research progress is reported on studies in heavy element chemistry. Topics considered are: synergistic complexes of plutonyl ion; water uptake in synergistic systems; formation constants of some uranyl β-diketone complexes; thermodynamic acid dissociation constants of β-diketones; thermodynamic formation constants of uranyl β-diketonates; thiocyanate complexes of some trivalent lanthanides and actinides; stability constants of actinide complexes using dinonyl naphthalenesulfonic acid extraction; TBP extraction of actinides; stability constants of complexes of Pu(III) with 5-sulfosalicyclic acid; and solvent extraction behavior of Pu(VII). (DHM)

12615 (BARC-690, pp 109-115) X-RAY STRUCTURAL STUDIES. 1973.

Research progress is reported on x-ray structural studies of heavy elements that includes oxalate and acetato complexes of U(VI) and tetraoxalato complexes of U(IV) and Np(IV). (DHM)

12616 (ORO-4447-6) PHYSICAL-CHEMICAL STUDIES OF TRANSURANIUM ELEMENTS. Progress Report, April 1, 1973-March 31, 1974. Peterson, J. R. (Tennessee Univ., Knoxville (USA). Dept. of Chemistry). 1974. Contract AT(40-1)-4447. 40p. Dep. NTIS $4.00.

New preparative and investigative techniques developed include: a low total heat capacity crucible and heating system for the preparation of actinide metals; small mass heating coils for annealing, quenching, spectroscopic, and chemical reaction studies; modification of an x-ray diffraction camera for high-temperature analyses. The first direct experimental measurement of the heat of solution of Bk metal in 1M HCl at 25°C resulted in a preliminary value of -138.2 ± 2.8 Kcal/mole. The first samples of ^{248}Cm metal were prepared and characterized, the series of known actinide nitrides was extended through Bk, and first results on the metallic state of Cf in bulk form were obtained. Studies on the effects of self-irradiation were continued by investigating the trifluorides and tribromides of ^{248}Cm and ^{244}Cm. Considerable progress was made in the developmental stage of an effort to generate and characterize spectrally and electrochemically a number of unusual oxidation states of actinides. Finally, the 5f electrons of Am and Cm were found by photoelectron spectrometry at $E_B \approx 5$ eV in the fluorides and at $E_B \approx 2$ eV in the oxides. (auth)

12617 CHEMISTRY OF URANIUM. VIII. Nitrate as a Ligand Towards Uranium(IV). Du Preez, J. G. H.; Van Vuuren, C. P. J. (Port Elizabeth Univ., S. Afr.). J. Inorg. Nucl. Chem.; 36: No. 1, 81-85(Jan 1974).

The behavior of NO_3^- as anionic ligand towards U(IV) in the presence of various amounts of hexamethylphosphoramide was studied in nonaqueous media by conductometric and spectroscopic methods. Various simultaneous equilibria were indicated in solution and conditions were established under which solid nitrato complexes, which differ in stoichiometry, can be isolated. The coordination modes of the nitrato groups were identified by means of IR spectroscopy. The donor action of nitrate towards uranium(IV) was compared to that of chloride. (auth)

12618 ELECTROMETRIC STUDIES ON THE INTERACTION BETWEEN SELENOUS ACID AND URANYL IONS. Verma, V. P.; Khandelwal, B. L. (Indian Inst. of Tech., New Delhi). Indian J. Chem.; 11: No. 6, 602-603(Jun 1973).

The behavior of selenous acid towards uranyl acetate solution was studied conductometrically. The plot of corrected conductance versus volume of selenous acid added to uranyl acetate solution shows two breaks: the first at 1 : 0.5 and the second at 1 : 1 molar ratios of UO_2^{2+} : SeO_3^{2-} corresponding to the formation of $(UO_2)_2SeO_3(OH)_2$ and UO_2SeO_3 respectively. In the reverse titration, only one break at 1 : 1 is observed. The composition of various products formed corresponding to the breaks in titration curves has been confirmed by their chemical analysis. A

new compound of composition $(UO_2)_2(OH)_2SeO_3.2H_2O$ is being reported. (auth)

12619 METHOD OF COORDINATING THE NITRITE ION WITH THE URANYL ION. Shchelokov, R. N.; Orlova, I. M.; Podnebesnova, G. V. (Inst. of General and Inorganic Chemistry, Moscow). Zh. Neorg. Khim.; 18: No. 7, 1886-1888(Jul 1973). (In Russian).

Guanidone nitritodioxalatouranylate was synthesized. Infrared absorption spectra of compounds and related complexes indicated that the nitrite ion is coordinated with the uranyl ion through the oxygen atom, i.e., it occurs as the nitrito ligand. (tr-auth)

12620 KINETICS OF HYDROGEN REDUCTION OF UO_3 AND U_3O_8 DERIVED FROM AMMONIUM DIURANATE. Le Page, A. H.; Fane, A. G. (Australian Atomic Energy Commission, Sutherland). J. Inorg. Nucl. Chem.; 36: No. 1, 87-92(Jan 1974).

The kinetics of hydrogen reduction of UO_3 and U_3O_8 derived from the calcination of ammonium diuranate were studied by thermogravimetric analysis between 500 and 650°C at atmospheric pressure over a range of hydrogen concentrations. Calcination of ammonium diuranate produced UO_3 below about 600°C and U_3O_8 above 600°C. The reduction of UO_3 took place in two steps: UO_3 to U_3O_8 and U_3O_8 to UO_2. The order of reaction with respect to unconverted solid was zero for the UO_3 to U_3O_8 step and varied from 0.65 to zero for the U_3O_8 to UO_2 step depending on hydrogen concentration and temperature. For both reactions, the order with respect to hydrogen concentration was 0.9. The activation energies were 44.0 kJ mol^{-1} for the UO_3 to U_3O_8 reaction and 88.5 kJ mol^{-1} for the U_3O_8 to UO_2 reaction. (auth)

12621 LEAST-SQUARES METHOD FOR THE IDENTIFICATION OF RESONANT GROUPS FROM NMR POWDER SPECTRA. Identification of Oxonium and Hydroxyl Ions in Hydrated Uranates. Sobry, R.; Rinne, M. (Univ., Liege). J. Magn. Resonance; 12: No. 2, 152-167(Nov 1973).

A general method to calculate NMR powder spectra with a predetermined precision is described. The calculated spectrum for one resonant group depends on short- and long-range dipolar interactions, α and β, and on the proportion of the resonant group in the chemical formula. A least-squares method is proposed to determine the best values of the parameters. To choose initial values, use is made of some easily measurable characteristic of the experimental spectrum and relations between them and the various parameters. Thus, the mathematical method suggested can be used to identify resonant groups and to state precisely the chemical formula of a polycrystalline solid. The theoretical calculation is applied to the hydrated uranates. The hydration water is shown to exist in the form of oxonium and hydroxyl ions according to Brasseur's hypothesis. The proposed method is used to refute some formulas as well as to specify the oxonium and hydroxyl parameters. The proton–proton distance in the equilateral triangle of the oxonium ions is found to be 1.72 Å. The limits of the method are discussed. Dehydration experiments show that the first dehydration step corresponds to the departure of the oxonium ions. (auth)

12622 ONE-ELECTRON REDUCTION SYNTHESIS OF URANIUM PENTAFLUORIDE. Asprey, L. B.; Paine, R. T. (Los Alamos Scientific Lab., NM). J. Chem. Soc., Chem. Commun.; No. 23, 920-921(5 Dec 1973).

The reactions of uranium hexafluoride with hydrogen gas in the presence of ultraviolet radiation or with silicon powder in an anhydrous HF slurry provide useful, high-yield synthesis of pure uranium pentafluoride. (auth)

12623 SORPTION OF URANYL ION ON CLAYS AS A FUNCTION OF pH, ANION STRUCTURE OF THE SOLUTION, TIME, AND MINERAL COMPOSITION OF THE CLAYS. Obretenov, Ts.; Zhekova, R. (Vissh Khimiko-Technologicheski Inst., Burgas, Bulgaria). Rudodobiv Met. (Sofia); 27: No. 6, 32-35(1972). (In Bulgarian).

The experimental tests are carried out using montmorillonite and kaolin clays. The montmorillonite clay is from Kyrdzhali and consists of montmorillonite with bayldonite and a little quartz. The kaolin clay is from Razgrad surroundings and consists of kaolin with a quartz addition. It is established that hexavalent uranium chemisorption on the clays depends on the hydrolytic form of UO_2^{+2}-ion, which changes according to pH of the solution. The most favorable solution acidity is considered to be in the pH range 5 to 7.5. The chemisorption does not depend on the anion composition of the solution if uranyl complex anions are not generated or if the latter have great affinity constants. For example, the anions Cl^-, SO_4^{-2} and NO_3^- have no influence on the uranyl-ion chemisorption. The hexavalent chemisorption is insignificant. In the presence of CO_3^{-2} the uranium exists as a stable uranyl carbonate anion which is not chemisorbed by the clays. It is established that kaolin clay chemisorbs a hexavalent uranium at the same degree as the montmorillonite in spite of the great difference in their ion-exchange capacity. A conclusion is drawn that ions in the clays have no decisive importance for the chemisorption of hexavalent uranium. (INIS)

12624 STABILITY OF LANTHANUM, YTTRIUM, SCANDIUM, AND THORIUM GLUTARATE AND OXALATE COMPLEXES IN AQUEOUS AND AQUEOUS-ALCOHOL SOLUTIONS. Chubakova, E. I.; Skorik, N. A. (Tomsk State Univ., USSR). Zh. Neorg. Khim.; 18: No. 10, 2723-2726(Oct 1973). (In Russian).

Stability constants were determined for the La, Y, Sc, and Th glutarate complexes, of the composition MA, in water and in mixtures of water with 19.8, 30.0, and 40.3 wt % ethanol; for the Sc and Th oxalate complexes of the composition MO_x and MHO_x in water, with an ion strength of 0.05 and at 25°C. A linear dependence between the logarithm of the stability constant of the glutarate complexes of the metals mentioned and a reverse value of the dielectric penetrability of the solvent were shown. (tr-auth)

12625 UF_4–NH_4F–H_2O SYSTEM AT 25°C. Koneva, L. G.; Borin, L. L. Zh. Neorg. Khim.; 18: No. 10, 2850-2852(Oct 1973). (In Russian).

The UF_4–NH_4F–H_2O system was studied at 25°C by a Schreinemakers ray method. The regions of existence of separate duplicate uranium fluoride phases, $6UF_4 \cdot 7NH_4F$, $(NH_4)_2UF_6$, $(NH_4)_4UF_8$, were determined. (tr-auth)

12626 EFFECT OF ANIONS ON THE RATE OF EXCHANGE OF LIGANDS AND SOLVATE DISPLACEMENT IN TRIBUTYL PHOSPHATE SOLUTIONS OF URANYL IONS. Vashman, A. A.; Vereshchagina, T. Ya.; Pronin, I. S. Zh. Neorg. Khim.; 18: No. 10, 2807-2813(Oct 1973). (In Russian).

From the temperature dependences of spin-spin nuclear magnetic relaxation times of ^{31}P, the exchange rates of ligands, and solvate displacements, the thermodynamic parameters of activation for solutions of uranyl chloride, bromide, nitrate, sulfate, and perchlorate in tributyl phosphate were determined. The exchange rate of ligands depended on the type of anion and increased in the sequence Cl, Br, NO_3, SO_4, ClO_4. The more labile complexes showed greater displacements. The effects of complex formation of the uranyl ion with tributyl phosphate are discussed. (tr-auth)

12627 PURIFICATION OF TRITIATED GENTAMICIN. Wilson, T. W.; Kadar, D.; Inaba, T.; Johnson, G. E. (Univ., Toronto). J. Label. Compounds; 9: No. 3, 559-562(1973).

A simple, high-capacity method for the purification of ^3H-gentamicin is described. Confirmation of radiochemical purity using several thin layer chromatography systems is presented. Based on the weight of biologically active material, the specific activity is 1.02 Ci/mM. (auth)

12628 OCTAHEDRAL HEXAFLUORO COMPLEXES OF THE TETRAVALENT ACTINIDES. Ryan, J. L. (Battelle Pacific Northwest Labs., Richland, WA); Cleveland, J. M.; Bryan, G. H. Inorg. Chem.; 13: No. 1, 214-218(Jan 1974).

Salts and solutions of the octahedral UF_6^{-}, NpF_6^{-}, and PuF_6^{-} ions were prepared. These represent a lower coordination number than previously known for tetravalent actinides in fluoro complexes. Absorption spectra of these hexafluoro complexes in the region of internal f-electron transitions are presented and are the weakest known for U(IV), Np(IV), and Pu(IV). (auth)

12629 ELECTROCHEMICAL STUDIES OF URANIUM AND THORIUM IN MOLTEN LiF–NaF–KF AT 500°C. Clayton, F. R. (Univ. of Tennessee, Knoxville); Mamantov, G.; Manning, D. L. J. Electrochem. Soc.; 121: No. 1, 86-90(Jan 1974).

Electrochemical studies of U(IV) in molten LiF–NaF–KF (46.5–11.5–42.0 mole percent) at 500°C reveal a two-step reduction process at a platinum electrode. The first step is complicated by disproportionation of U(III) to regenerate U(IV); the second step involves formation of uranium metal. Standard electrode potentials with respect to a unit mole fraction Ni(II)/Ni electrode are estimated for the U(IV)/U(III) and U(III)/U couples as –1.41 and –1.81V, respectively. These values must be considered tentative because of complications in the electrode process. The voltammetric oxidation of U(IV) at platinum and pyrolytic graphite electrodes in LiF–NaF–KF occurs at ~+1.3V vs. a Ni(II) (saturated)/Ni reference electrode. The results point to the disproportionation of electrochemically generated U(V). In voltammetric studies of Th(IV) in molten LiF–NaF–KF at 500°C, a reduction wave is obtained at nickel and tungsten electrodes, with a peak potential of –2.02 V (vs. a Ni(II) (saturated)/Ni reference electrode). Analysis indicated that Th(IV) is reversibly reduced to the metal with alloy formation between the deposited thorium and the nickel. A standard electrode potential for the Th(IV)/Th couple in this melt is calculated to be –2.13V vs. a unit mole fraction Ni(II)/Ni electrode. (auth)

12630 KINETICS OF TYPICAL HYDROLYSIS REACTIONS OF MULTIVALENT CATIONS. Wendt, H. (Technische Hochschule, Darmstadt, Ger.). Chimia (Aarau); 27: No. 11, 575-588(15 Nov 1973). (In German).

This review summarizes kinetic investigations concerning the homogeneous hydrolysis reactions of multivalent metal cations in aqueous solution. Three main types of reactions are discussed: a) protolysis of aquated cations to form mononuclear metal-hydroxo complexes; b) the formation and fission of binuclear μ-hydroxo-bridged or μ-oxo-bridged metal-hydroxo complexes; and, c) the formation and acid degradation reactions of higher polynuclear metal-hydroxo complexes. Whereas the protolysis reaction of aquo-metal cations is a simple and fundamental (acid dissociation) reaction the formation of the binuclear complexes resembles in most cases closely the metal-anion-complex formation. The formation and degradation of the higher metal-hydroxo complexes, however, mostly proceeds in two or more parallel reaction paths. Both the successive addition of mononuclear metal-hydroxo species to metal-hydroxo complexes of lower molecular weight as well as the initial formation of discrete sub-complexes which finally combine to the stable complex are observed for the formation reaction. (auth)

12631 NEW SULFIDES OF URANIUM AND 3d TRANSITION SERIES ELEMENTS. Noel, H. (Univ., Rennes, France). Compt. Rend., Ser. C; 277: No. 12, 463-464(24 Sep 1973). (In French).

New MUS_3(M = V, Cr), Co-U_2S_5, and MU_6S_{11}(M = Ti, V, Cr, Mn) sulfides were prepared by solid-state reactions. Their crystallographical properties are given. The MUS_3 compounds are $ScYS_3$ isotypes. MU_6S_{11} constitutes an isostructural series (M from titanium to nickel). (FR)

12632 POWDER-DIFFRACTION DATA FOR $U_3O_5P_2O_7$. Schaekers, J. M.; Greybe, W. G. (Atomic Energy Board, Pelindba, S. Afr.). J. Appl. Crystallogr.; 6: No. 3, 249(1 Jun 1973).

X-ray powder-diffraction data were obtained for $U_3O_5P_2O_7$. This compound has not yet been mentioned in the literature, although similar diffraction data have been reported for a compound described as $(UO)_3(PO_4)_2$. (auth)

12633 EUROPIUM-151 MOESSBAUER SPECTROSCOPIC STUDIES OF AFTER-EFFECTS OF THE ELECTRON-CAPTURE DECAY OF GADOLINIUM-151 AND THE β-DECAY OF SAMARIUM-151. Glentworth, P.; Nichols, A. L.; Large, N. R.; Bullock, R. J. (Univ. of Leeds, Eng.). J. Chem. Soc., Dalton Trans.; No. 21, 2364-2369(1973).

^{151}Eu Moessbauer spectrometry was used to study the after-effects of electron-capture decay of ^{151}Gd and β-decay of ^{151}Sm in inorganic and organic lanthanide compounds doped with these nuclides. No charge state other than $^{151}Eu^{(III)}$ was observed following nuclear decay in lanthanide oxides and fluorides doped with ^{151}Gd or ^{151}Sm. However, both the bivalent state, $^{151}Eu^{(II)}$, and the tervalent state, $^{151}Eu^{(III)}$, were observed following the electron-capture decay of ^{151}Gd-doped organic lanthanide compounds. The effects of varying temperature, the organic ligand, and the lanthanide matrix element were investigated. The presence of water of crystallization was not essential for the production and stabilization of $^{151}Eu^{(II)}$ in lanthanide oxalates. The presence of a conjugated organic ligand in ^{151}Gd-doped compounds suppressed the formation of $^{151}Eu^{(II)}$. (auth)

12634 DIMETHYL SULPHOXIDE COMPLEXES OF SOME ACTINOID TETRANITRATES. Alvey, P. J.; Bagnall, K. W.; Brown, D. (Univ. of Manchester, Eng.). J. Chem. Soc., Dalton Trans.; No. 21, 2326-2330(1973).

Complexes of some actinoid tetranitrates with dimethyl sulfoxide (dmso), $M(NO_3)_4$. xdmso [x = 6(Th, Np, and Pu) and 3(Th, U, Np, and Pu)] have been prepared by reactions in non-aqueous media. IR and Raman spectral results are reported for these complexes together with IR spectra of the hexanitrato-complexes Cs_2 [$M(NO_3)_6$] (M = Th and Np). X-ray powder diffraction data are also presented together with details of the electronic spectra of the uranium, neptunium, plutonium complexes. (auth)

12635 SULPHOXIDE COMPLEXES OF ACTINOID TETRAHALIDES. Alvey, P. J.; Bagnall, K. W.; Brown, D.; Edwards, J. (Univ. of Manchester, Eng.). J. Chem. Soc., Dalton Trans.; No. 21, 2308-2314(1973).

Complexes of actinoid tetrachlorides with sulfoxides MCl_4. xR_2SO [R = Et, x = 4(Th), 3(Th, U, or Np), and 2.5(Np or Pu); R = Ph, x = 4(Th, U, or Np) and 3(U, Np, or Pu); R = $C_{10}H_7$, x = 3(Th or U)] have been prepared. IR spectra, including tentative assignments for metal-halogen stretching frequencies in these complexes and the uranium tetrabromide complexes UBr_4. yR_2SO (R = Me, y = 8 and 6; R = Et, y = 5; R = Ph, y = 4), are reported. X-ray powder diffraction data are also presented and the electronic spectra of the uranium tetrachloride complexes are discussed. (auth)

12636 THERMODYNAMIC PROPERTIES OF HAFNIUM AND THORIUM HALIDES. Krasnov, K. S.; Morozov, E. V.; Filippenko, N. V.; Giricheva, N. I. (Ivanovo Chemical Engineering Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Khim. Tekhnol.; 16: No. 10, 1500-1503(1973). (In Russian).

The thermochemical properties and molecular constants needed for calculating hafnium and thorium halide thermodynamic functions are evaluated. (tr-auth)

12637 PHASE EQUILIBRIA IN MeCl–$PuCl_4$. Vorobei, M. P.; Skiba, O. V.; Bevz, A. S. Zh. Neorg. Khim.; 18: No. 9, 2506-2511 (Sep 1973). (In Russian).

Differential-thermal, x-ray structure, and spectrometric methods were used in analyzing phase equilibria in MeCl–$PuCl_4$ systems in the composition range 0 to 30 mole % $PuCl_4$; eutectic points and melting points were determined. The existence of a number of congruently melting chemical compounds, Me_2PuCl_5 (Me = K, Rb, Cs), was established. (tr-auth)

Radioactive Waste Treatment

Refer also to abstract 13269.

12638 (BNWL-1776) FEASIBILITY EVALUATION AND R AND D PROGRAM PLAN FOR TRANSURANIC PARTITIONING OF HIGH-LEVEL FUEL REPROCESSING WASTE. Bray, L. A.; Burger, L. L.; Burns, R. E.; Ryan, J. L. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Nov 1973. Contract AT (45-1)-1830. 78p. Dep. NTIS $5.45.

An approach to managing high-level radioactive waste is to separate it into fractions of different half-lives. Existing separations technologies were reviewed and their potential for this application assessed, process concepts expected to be capable of these separations were defined, areas where R&D to develop and design an effective process is required were identified, and an R&D plan for selection and development of a partitioning process was prepared. A wide spectrum of technologies was initially considered. The review concluded that, of all of the alternatives available, solvent extraction and ion exchange separations of the types already widely used in the nuclear industry offer the best prospects for a cost effective process. Partitioning using these technologies to achieve transuranium element decontamination factors on the order of 100 is expected to be feasible. While these technologies exist, they have generally been applied for recovery purposes rather than for the separations purposes needed for partitioning. An R&D program plan for waste partitioning is discussed. (LK)

12639 (Y-1886) RECOVERY OF NITRIC ACID FROM RAFFINATE AND CONDENSATE SOLUTIONS BY STEAM DISTILLATION/PYROHYDROLYSIS AND FRACTIONAL DISTILLATION IN A GLASS COLUMN. Dietrich, W. C. (Oak Ridge Y-12 Plant, Tenn. (USA)). 28 Dec 1973. Contract W-7405-eng-26. 25p. Dep. NTIS $4.00.

Potential processes for the pilot-plant-scale purification and concentration of nitric acid condensate and raffinate solutions were studied. As a result, a process was developed where condensates were continuously purified by an aluminum nitrate-calcium nitrate trap to reduce 200 to 300-ppM fluoride concentrations to <1 ppM. Next, the condensates were fed to an all-glass rectification column to concentrate nitric acid to 14 molar and to reduce 200 to 400-ppM chloride concentrations to <1 ppM. Finally, raffinates were steam distilled and pyrohydrolyzed to recover > 90% of the nitrates as nitric acid. (auth)

12640 STUDIES ON THE SORPTION AND FIXATION OF CESIUM BY VERMICULITE. Lee, S. H. (Korea Atomic Energy Research Inst., Seoul). J. Korean Nucl. Soc.; 5: No. 4, 310-320(Dec 1973).

The sorption and fixation of cesium in dilute solutions by vermiculite saturated with Na or K were studied in order to investigate any possibility of its use in radioactive effluent treatment. The cesium sorbed by vermiculite with the increase in pH is attributed to the increase of sorption surface as a result of the dispersion. The increased cesium sorption by Na-vermiculite is due to the different sorption rates by the different exchange sites: external surface and internal surface. It is shown that the larger amount of sorbed cesium was extracted by KCl rather than with any other extractants. It is suggested that the fixation of cesium by vermiculite occurs at the crystal edge where Cs may replace K. Domestic vermiculite is a valuable material for use in the cesium sorption and fixation, and might be useful as a good packing material outside the tank of highly radioactive liquid waste. And from these results one could suggest that the artificial alteration of the biotite to vermiculite might be occurring by treating with NaCl. (auth)

12641 PROCESSING OF RADIOACTIVE WASTES. Cuaz, D.; Pottier, P.; Thiery, D. (to Commissariat a l'Energie Atomique). French Patent 2,129,836. 16 Mar 1971. 8p. (In French).

A method for processing radioactive wastes is presented. A special feature of the method is that radioactive wastes, which have already been made into a dry powder form, are incorporated in a resin, which can be polymerized at room temperature, and that the copolymerization of the resin is then effected in such a manner as to obtain a solid block. An unsaturated polyester is used as the resin. Styrene is used as the monomer. (FR)

Radioisotope Production

Refer also to abstracts 12531, 13311, and 15099.

12642 (BARC-690, pp 9-13) TRANSPLUTONIUM ELEMENTS. Sivaramakrishnan, C. K.; Jadhav, A. V.; Reghuraman, K.; Mathew, K. A.; Nair, P. S.; Ramaniah, M. V. 1973.

Research progress is reported on studies of the transplutonium elements including recovery and purification of americium, preparation of ^{238}Pu, extraction studies using diethylhexyl phosphate. (DHM)

12643 PRODUCTION OF ^{83}Rb AND DEVELOPMENT OF AN ISOTOPE GENERATOR FOR THE SEPARATION OF ^{83m}Kr FROM ^{83}Rb. Extract. Krueger, A. Darmstadt, Ger.; Technische Univ. (1972). 4p. (In German).

Thesis.

Basic fixation and elution studies have been made with the radioisotope generator system $^{83}Rb/^{83m}Kr$. The ^{83}Rb has been produced from ^{85}Rb by a $(\gamma,2n)$ nuclear reaction and has been fixed on different carrier materials, such as Dowex 50WX12 and zirconium phosphate among others. Liquid phase as well as gas phase studies have been made and the decontamination and yield factors have been determined. Aluminium oxide was the best carrier material for a rapid separation of carrier-free ^{83m}Kr in the gas phase. (GE)

12644 NUCLEAR REACTOR PRODUCTION OF CARRIER-FREE ^{32}Si. Forberg, S. (Kungliga Tekniska Hoegskolan, Stockholm). Radiochim. Acta; 18: No. 4, 194-197(1973).

Various suggested paths for the reactor production of the long-lived ^{32}Si are compared. The reaction series $^{31}P(n,\gamma)^{32}P(n,p)^{32}Si$ was found to be the most promising. Experiences from absolute activity measurements by means of Cherenkov radiation and yields from reactor neutron irradiations of phosphorus are presented. (GE)

12645 CYCLOTRON PRODUCTION OF LEAD-203 FOR RADIOPHARMACEUTICAL APPLICATIONS. Merrill, J. C.; Lambrecht, R. M.; Wolf, A. P. (Brookhaven National Lab., Upton, NY). Int. J. Appl. Radiat. Isotop.; 24: No. 12, 701-702(Dec 1973).

Cyclotron production of ^{203}Pb by the nuclear reactions $^{203}Tl(p,n)^{203}Pb$ (particle energy 12.5 MeV), $^{203}Tl(p,n)^{203}Pb$ (particle energy 16.2 MeV), $^{203}Tl(p,n)^{203}Pb$ (particle energy 20 MeV), $^{203}Tl(d,2n)^{203}Pb$, $^{203}Tl(^3He,3n)^{203}Bi \rightarrow ^{203}Pb$, and $^{203}Tl(\alpha,4n)^{203}Bi \rightarrow ^{203}Pb$ are surveyed. Yields, after a described chemical separation, are listed. These data indicate that the optimum method for production of ^{203}Pb is the $^{203}Tl(d,2n)^{203}Pb$ reaction. The beam energy required is, unfortunately, not available at most compact medical cyclotrons. However, a compact cyclotron with a 15-MeV proton beam can produce sufficient quantities of the nuclide for radiopharmaceutical research and development. (UK)

12646 CHEMICAL PROCESSING OF IRRADIATED ACTINIDE TARGETS. Koehly, G.; Madic, C.; Faudot, G.; Sontag, R. (CEN, Fontenay-aux-Roses, France). Bull. Inform. Sci. Tech. (Paris); No. 185, 31-49(Oct 1973). (In French).

Studies on the chemical processing of irradiated targets for the preparation of transuranic elements are presented. All the studies were orientated towards the development of processes for working in nitric acid media. Three methods of separating elements having very similar chemical properties were tested: the modification of the properties of the extracting agent by the addition of carboxylic (in view of obtaining a negative synergism); the modification of the oxidation-reduction properties in the presence of an extracting agent; and the modification of the affinities of trivalent ions for solvents by the formation of complex with polyaminoacetic compounds. A brief description is given of the processes used to prepare the transuranic elements ^{239}Pu, ^{243}Am, and ^{244}Cm used at the Fontenay-aux-Roses nuclear research center. (FR)

Reactor Fuel Reprocessing

Refer also to abstracts 12501, 12528, and 12552.

12647 (BARC-690, pp 1-9) PROCESS CHEMISTRY OF NEPTUNIUM. Srinivasan, N.; Ramaniah, M. V.; Nadkarni, M. N.; Kumar, S. V.; Patil, S. K.; Ramakrishna, V. V.; Swarup, R.; Avadhany, G. V. N.; Sonawane, R. R.; Kartha, P. K. S. 1973.

Research progress is reported on the recovery of neptunium from reprocessing of irradiated uranium. Areas considered are: use of vanadium(V) for oxidation of Np(V) to Np(VI); path of neptunium under partitioning column conditions; co-stability of Np(IV) and Pu(IV); and extraction of Np(IV) by tricaprylmethylammonium nitrate. (DHM)

12648 (BARC-690, pp 13-22) IN-LINE ANALYSIS OF FUEL REPROCESSING STREAMS. Bhagava, V. K.; Iyer, R. H.; Marathe, S. G.; Rao, V. K.; Ramaniah, M. V.; Srinivasan, N. 1973.

In continuation of the development work on the in-line analysis of fuel reprocessing streams, investigations were carried out on γ absorptiometry for uranium, γ monitoring for fission products, and neutron monitoring for plutonium. (DHM)

12649 (BNWL-CC-594) 234-5 BANK TANK CIRCULATION STUDIES. Dunn, J. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). [nd]. Contract AT(45-1)-1830. 12p. Dep. NTIS $3.00.

In the Plutonium Reclamation Facility a critically-safe geometry of the processing vessels, combined with economical utilization of building space, has resulted in manifolded, vertical tanks for blending, receiving, holding, etc. The pumps attached to the bottom-outlet manifolds of the tanks are of a canned motor type. The extremely short life of these pumps (considerably below that expected even in severe abrasive and corrosive service) prompted a series of studies using glass tanks containing process solutions which, except for the associated radioactivity, duplicate plant process streams. Circulation, blending, and reaction characteristics of simulated process streams in glass duplicates of the 234-5 Bank Tanks TK-17, TK-27, and TK-37 revealed circulation patterns that result in intermittent cavitation within the canned motor transfer pumps. This cavitation, combined with the unavoidable corrosion and abrasion, rapidly destroys the pumps. The circulation patterns, under varying liquid levels as encountered in plant operation, cause single and dual phase transfer of the organic-aqueous solutions to process columns at different times, which results in flooding and erratic extraction efficiencies. Reduction of cavitation and elimination of mixed phase transfer has been demonstrated by means of parallel controllable orifices in the external circulation lines. Elimination of cavitation and uniformity of mixing in the four separate vessels comprising the bank-tank assembly have also been demonstrated by means of changes in the inlet and outlet manifolds. The reduction of cavitation can be accomplished by changes in the system components remotely located from the tanks proper, i.e., in piping located in hoods. Complete elimination of cavitation and uniformity requires alteration of the tank headers and, while more desirable, also entails appreciable cost. (auth)

12650 (DOCKET-50201-146) WEST VALLEY REPROCESSING PLANT. Environmental Report. (Nuclear Fuel Services, Inc., Rockville, Md. (USA)). 13 Dec 1973. 784p. Dep. NTIS $41.25.

An evaluation is presented of the environmental impact of NFS' planned Reprocessing Plant modifications. Subjects covered include: purpose of proposed modified facility; developed plant areas at the center; physical characteristics of the local environment; environmental radioactivity at the center; the NFS reprocessing plant; environmental effects of reprocessing plant modifications and construction; environmental effects of plant operation; effluent and environmental measurements and monitoring programs; environmental effects of accidents; economic and social effects of plant construction and operation; alternatives to NFS' reprocessing plant modification program; plant design alternatives; summary environmental benefit-cost analysis; specific environmental impact considerations set forth in NEPA and 10CFR50, Appendix D; and environmental approvals and consultation. (DHM)

12651 APPLICATION OF AMBERLITE XE-270 RESIN TO PURIFICATION OF NEPTUNIUM. Schulz, W. W. (Atlantic Richfield Hanford Co., Richland, WA). Nucl. Technol.; 21: No. 1, 16-25(Jan 1974).

Amberlite XE-270, a macroreticular weak-base ion-exchange resin, was used successfully over an 8-month period in the Hanford Purex plant to purify ~8 kg of ^{237}Np. For routine purification of ^{237}Np, the Amberlite XE-270 resin provides four important advantages over conventional microreticular strong-base resins used heretofore: greatly improved thorium decontamination performance, a much sharper neptunium elution band, operation at 25°C rather than at 40 or 50°C, and five-fold lower resin cost. (auth)

12652 IMPROVEMENTS IN OR RELATING TO THE PROCESSING OF IRRADIATED NUCLEAR REACTOR FUEL. Mills, A. L.; Lillyman, E.; Bell, P. G. (to United Kingdom Atomic Energy

Authority). British Patent 1,330,535. 19 Sep 1973. Filed date 7 Jul 1970. 4p.

The process described involves contacting the irradiated fuel in nitric acid solution with tributyl phosphate (TBP) diluted with an inert organic diluent, such as CCl_4 or n-dodecane, to transfer the fissile material to the organic phase, separating the organic phase from the aqueous phase, and back-washing with aqueous H_2SO_4 to return the fissile material to the aqueous phase. The concentration of TBP in the diluent is 6 vol %. The effect of lowering the TBP concentration from the normal 20 to 30% to this lower value is to decrease the density of the organic phase and to reduce its viscosity. This eases separation of the organic and aqueous phases after contacting and allows more organic liquor to be fed through a given plant and hence the processing of more fuel. It has also been found to give better decontamination from major fission products. Full advantages of this improved process are obtained only if aqueous H_2SO_4 is used for back-washing. Using the conventional weak HNO_3 back-wash gives rise to large volumes of liquid which are difficult to handle in subsequent extraction cycles and may reduce decontamination factors. All traces of interface instability and interfacial "Crud" are avoided. Applications to Dounreay fast reactor fuel processing are described. (UK)

ENGINEERING

Energy Conversion

Refer also to abstracts 13067, 13111, 14328, 14450, 14706, 14710, and 15017.

12653 (JPRS-60972) EXPERIMENTAL RESEARCH ON MODEL MHD GENERATOR U-02 (STAGE II). Scientific and Technical Report 17/73. (Joint Publications Research Service, Washington, D. C. (USA)). 11 Jan 1974. Translated from pp 1-5; 12-311 of Eksperimental'nye Issledovaniya na Model'noy Energeticheskoy MGD Ustanovke U-02 (II Etap). Nauchno-Tekhnicheskii Otchet 17/73, Moscow, 1973. 304p. NTIS.

Basic results of stage II of research on a model combined MHD power plant (the U-02 installation) are presented. The research was conducted in order to investigate the basic physical processes that take place in parts of the open-cycle MHD generator. (JPRS)

12654 (NYO-3500-11) PRELIMINARY INVESTIGATION OF III-V COMPOUND THERMOELECTRIC MATERIALS DIRECTED TOWARD SEGMENTED SILICON–GERMANIUM III-V COMPOUND ADVANCED NUCLEAR POWER SYSTEMS. Topical Report for the Period September 1, 1965–February 28, 1966. (Radio Corp. of America, Harrison, N.J. (USA). Direct Energy Conversion Dept.). 31 Mar 1966. Contract AT(30-1)-3500. 62p. Dep. NTIS $5.25.

Declassified 30 Aug 1973.

Progress on the couple design, testing and reliability, optimization of material fabrication, and advanced technology is reported. (TFD)

12655 (SLA-73-80) SCREEN-PRINTING OF 1720 AND 7059 GLASS INSULATING BONDS FOR THE RADIOISOTOPIC THERMOELECTRIC GENERATOR. Jennings, C. W. (Sandia Labs., Albuquerque, N.Mex. (USA)). Dec 1973. Contract AT(29-1)-789. 27p. Dep. NTIS $3.50.

As part of the RTG fabrication sequence, Si/Ge and Si/Ge-glass substrates are coated with Corning 1720 and 7059 glass by a screen-printing process. A slurry of glass, pine oil, and terpinol is printed, followed by a burnout of the organic matter in oxygen at 500°C. It has been determined from overall fabrication considerations that there should be sufficient glass present to yield a fused-glass thickness of 1.2 to 1.4 mils. Glass content of the slurry, screen size, squeegee pressure, and breakaway distance are the important parameters affecting the amount of glass printed. Less variability in glass thickness is experienced when the screen contacts the substrate during printing. This occurs at higher squeegee pressures. The desired glass thickness is achieved by adjusting the glass content of the slurry to the screen mesh size, i.e., less glass is needed for an 80-mesh screen than for a 105-mesh screen. Not all of the slurry is retained on the substrate during printing; the fraction adhering to the screen is a function of the breakaway distance. Moderate slurry viscosity and temperature changes during screen printing have only minor effects on the thickness of the glass deposited. Routine printing of 1720 and 7059 glass slurries with 65- and 70-% glass have consistently yielded glass thicknesses between 1.2 and 1.4 mils. (auth)

12656 EFFECT OF IONIZATION TURBULENCE ON THE OPERATION OF AN MHD GENERATOR OPERATING WITH A NONEQUILIBRIUM PLASMA. Zampaglione, V. (Laboratory for the Direct Conversion of Energy, Rome, Italy). High Temp. 10: No. 6, 1053-1057 (July 1973).

The article gives a refined evaluation of the effect of ionization turbulization on the operation of a magnetohydrodynamic generator working with a nonequilibrium plasma. It discusses calculations based on approximated models of a turbulent plasma. (auth)

12657 THERMIONIC ENERGY CONVERSION. Volume I. Processes and Devices. Hatsopoulos, G. N.; Gyftopoulos, E. P. Cambridge, MA; Massachusetts Institute of Technology Press (1973). 276p. (TID-26507). $17.95.

Following an introduction which reviews the basic phenomena of thermionic conversion and the types and characteristics of typical thermionic converters, detailed information is presented on the ideal performance of diode thermionic converters, vacuum thermionic converters, and vapor thermionic converters. (LCL)

Facilities and Equipment

Refer also to abstracts 15096, 15182, 15186, 15188, 15189, and 15192.

12658 (ANL-CT-73-27) EVALUATION OF STEAM-TO-SODIUM LEAK DETECTORS ON THE SCTI, PHASE II. McKee, J. M.; Skladzien, S. B. (Argonne National Lab., Ill. (USA)). Dec 1973. 113p. AT.

Instruments for detecting leakage of steam into sodium were in operation on the Sodium Components Test Installation (SCTI) at the Liquid Metal Engineering Center (LMEC) during a 17-month performance test of the Atomics International Modular Steam Generator (MSG). No leaks occurred in the MSG, but leaks were simulated by controlled injections of hydrogen and steam into the sodium to measure the effectiveness of the detectors. Two short periods of injection tests were fitted into the MSG test schedule. Three hydrogen and 29 steam injections were made into the MSG sodium inlet line in the first period. Eighteen hydrogen injections were made directly into the MSG near the top and bottom tubesheets in the second period. The results of these injection tests are presented. The SCTI leak detection system consisted of two ANL hydrogen detectors and two Westinghouse oxygen meters in the sodium and a gas chromatograph monitoring hydrogen in the cover gas. (auth)

12659 DESIGN OF PLATES AND SHELLS OF UNIFORM STRENGTH BY MEANS OF RADIOACTIVE IRRADIATION. Kalabegashvili, M. G. Soobshch. Akad. Nauk Gruz. SSR; 72: No. 2, 301-304(Nov 1973). (In Georgian).

Some axially symmetrical problems on the design of circular plates and cylindrical shells of uniform strength by means of radioactive irradiation are described. The problems are solved numerically using the method of successive approximations. (auth)

12660 FURNACE FOR COATING PARTICLES AT HIGH TEMPERATURE. (to Joint Nuclear Research Center, Ispra, Italy). Dutch Patent 7,017,280. 27 Nov 1970. 1p. (In Dutch).

A furnace is described for the batch-wise coating of particles in a heated fluidized bed, comprising a graphite reaction chamber and a graphite heater which can be heated by a direct passage of current and which is disposed concentrically around the reaction chamber. The reaction chamber is electrically connected to a first conducting lead via a first electrically-conducting, coolable block and is also electrically connected by a sliding contact to the graphite heater which is electrically connected to a second conducting lead via a second, electrically conducting, coolable block, the first and second blocks being insulated from one another. This furnace has a very good thermal efficiency. (INIS)

12661 FLUIDIZATION CHAMBER FOR COATING MATERIAL PARTICLES. Flamm, H. J. (to Joint Inst. for Nuclear Research, Ispra, Italy). Dutch Patent 7,114,711. 26 Oct 1971. 1p. (In Dutch).

Fluidized bed coating chambers, as applied to coating of nuclear fuel particles, usually consist of a conical lower section extending into an upper cylindrical part. From the point of heat transfer a trough-type coating chamber is proposed, comprising two side walls, two transverse walls and a base. The four walls have their lower edges resting in a groove at the base and are held by a closure block. By replacing the loose side walls by larger or smaller ones, different quantities of material particles may be treated by means of the same oven unit. (INIS)

12662 APPARATUS FOR CRUSHING, MIXING, AND LUBRICATING POWDERS. (to Commissariat a l'Energie Atomique.) French Patent 2,142,625. 22 Jun 1971. 10p. (In French).

An apparatus for crushing, mixing, and lubricating powders for preparing uranium or plutonium oxide nuclear fuels is described. It consists of a U shaped part with a recipient-crusher between its arms, the axis of revolution of the recipient-crusher being parallel to these arms. The recipient-crusher can pivot freely about this axis. A second recipient with a valve attached to its side wall is rigidly fixed by its mouth to the mouth of the recipient-crusher. The U shaped part is fixed to the upper part of a special frame. Two coaxial tubular parts are fitted to the outside of the arms of the U shaped part in such a way that their common axis is perpendicular to the axis of revolution of the recipient-crusher. One of the tubular parts is coaxially traversed by an axle. The apparatus is provided with a device for rotating this axle about its axis and a device for rotating one of the tubular parts about its axis. (FR)

Heat Transfer and Fluid Flow

Refer also to abstracts 14594, 14618, 14641, 14679, 14690, 14728, 14788, and 15133.

12663 (CONF-730578-) FIRST AUSTRALASIAN CONFERENCE ON HEAT AND MASS TRANSFER, MONASH UNIVERSITY, MELBOURNE, AUSTRALIA, MAY 23–25, 1973. (Monash Univ., Clayton (Australia)). 1973. 665p.

Seventy-six papers were presented at the meeting. A separate abstract was prepared for each of 5 papers. The remaining 71 papers which were not within the scope of NSA contain information on heat transfer in the earth's atmosphere, internal and external heat transfer in biological systems, heat transfer in engineering systems not related to nuclear applications, measuring methods and equipment, transfer through solid and porous media, and heat transfer with chemical reaction. (LCL)

For abstracts of individual papers see: 12664–12668.

12664 (CONF-730578-, pp 9-16 Sect. 4.3) SOME EXPERIMENTAL RESULTS FOR HEAT AND MOMENTUM TRANSFER TO A LIQUID BOILING IN UPWARDS FLOW IN A VERTICAL ANNULUS. Dolan, D. S. (Bechtel Pacific Corp. Ltd., Melbourne); Tait, R. W. F. 1973.

From first Australasian conference on heat and mass transfer; Melbourne, Australia (23 May 1973).

The apparatus used to measure local heat transfer coefficients and pressure gradients for upwards flow of pure liquids boiling in a concentric 1" × 1.5" annulus, and the experimental results obtained, are described. Two outer test sections were used. One was a pyrex glass tube to permit observation of the two-phase flow regimes. The other was an electrically heated copper tube. Techniques were developed for embedding thermocouples in the electrically heated inner and outer test sections over their entire length, thus enabling local heat transfer measurements to be made. Independently controlled flows of vapor and saturated liquid were fed to the bottom of the annular gap between the test sections. The effects of liquid and vapor flow rate, heat flux, and an equivalent heat flux applied to the other surface, on the heat transfer coefficient were studied for water and ethanol. The investigation was concentrated on the forced convection or liquid film flow region in which heat is transferred across the liquid film by conduction and eddy convection. Correlations of the local heat transfer coefficient in the forced convection regime showed that there was a significant difference in the effect of vapor flow rate for water and ethanol, the heat transfer coefficient being proportional to the vapor flow rate to the 0.82 power for water and to the 0.50 power for ethanol. The effect of liquid flow rate for water and ethanol was similar. The two-phase flow pressure gradients were measured using liquid purged monometers, with small bore pressure tappings in the outer surface of the annulus. (auth)

12665 (CONF-730578-, pp 17-24 Sect. 4.3) EFFECT OF SPACERS ON BURNOUT IN AN ANNULUS WITH A UNIFORMLY HEATED CENTRAL ROD COOLED BY FREON-12. Ilic, V.; Lawther, K. R. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). 1973.

From first Australasian conference on heat and mass transfer; Melbourne, Australia (23 May 1973).

The effect of spacer elements on flow boiling burnout conditions in an annulus was investigated with a stainless steel test section having a 14.4 mm dia heater rod, 2743 mm long, in a 22.1 mm id tube, and using Freon-12 at a pressure of 1.035 MPa. The spacer elements were Tufnol cylinders of 3.8 mm dia, 12.7 mm long, and were used in sets of three, equally spaced around the heater rod. Three spacing arrangements were used: an essentially bare heater; sets of spacer elements at 304.8 mm pitch; and sets of spacer elements at 152.4 mm pitch. Results show that, depending on flow conditions (mass velocity and inlet temperature) and spacer arrangements, the spacers can have significant effects on burnout power. For some conditions the presence of spacers can cause a substantial increase in burnout power (an increase of approx. 80% was obtained); for other conditions the effect can be negligible, or even some reduction in burnout power can result. (auth)

12666 (CONF-730578-, pp 25-32 Sect. 4.3) CONDENSATION INSIDE A HORIZONTAL TUBE. Connel, M. P.; Wood, D. G. (Univ. of Melbourne). 1973.

From first Australasian conference on heat and mass transfer; Melbourne, Australia (23 May 1973).

Experimental results for horizontal "in-tube" condensation are presented. The variation of local heat transfer coefficients measured at axial and circumferential locations is demonstrated and a model based on fundamental transport equations is used to analyze results for laminar condensate films. The transition from a region of high laminar significance–low turbulent significance to low laminar significance–high turbulent significance is clearly demonstrated. (auth)

12667 (CONF-730578-, pp 41-49 Sect. 4.3) MOMENTUM AND INTERFACIAL FRICTION FORCES IN FORCED CONVECTION CONDENSATION. Pittas, A. C. (Univ. of Tasmania, Hobart, Australia); McKenzie, R. T. B. 1973.

From first Australasian conference on heat and mass transfer; Melbourne, Australia (23 May 1973).

Filmwise condensation of pure saturated vapors in tubes was analyzed on the assumption of laminar annular condensate flow, by the application of the continuity, momentum and energy equations averaged over the cross-section. The resulting governing differential equations were solved numerically. The effect of the momentum and interfacial friction forces was investigated from a study of three versions of the physical model in the complete condensation of water, ammonia, and refrigerant-12 vapors in vertical down flow in tubes. For an upper limit of vapor entry Reynolds numbers of 50,000 it was shown that gravity is the dominant flow force, particularly in the case of refrigerants with high vapor-to-liquid density ratios compared to water. Momentum forces do not appreciably affect the thermal characteristics of the process and an attempt to include momentum effects in semi-empirical correlations is considered unjustifiable. Interfacial shear has a small overall effect on the rate of condensation for the range of Prandtl numbers $1 < Pr < 10$. These conclusions are in agreement with observations of other researchers. The agreement with experiment was satisfactory. (auth)

12668 (CONF-730578-, pp 41-48 Sect. 4.2) EXPERIMENTAL INVESTIGATION OF THE TURBULENT EXCHANGE OF MASS BETWEEN ROD SUBCHANNELS. Green, W. J.; Hooper, J. D. 1973.

From first Australasian conference on heat and mass transfer; Melbourne, Australia (23 May 1973).

The analysis of the thermal performance of fuel assemblies in nuclear power reactor cores is discussed. An experimental approach to the determination of turbulent mass exchange between fuel rod subchannels is outlined. In a reactor fuel assembly a subchannel can be defined by the flow area contained within straight lines joining the centers of rod fuel elements in square or triangular lattice array. Within such an arrangement for turbulent flow conditions there are basically two methods of exchange between the flow subchannels. One mechanism is caused by the pressure gradients existing between subchannels, and the other by the turbulent diffusion of mass and heat. The effects of geometrical configuration on the turbulent mass exchange process both within a subchannel and between subchannels were examined using a 16-rod square pitch lattice as the rod array. The ratio of rod gap to rod dia was varied between 0.07 and 1.2, at a Reynolds number of approximately 5×10^4. Air was used as the working fluid, the isokinetically injected nitrous oxide tracer gas was employed to determine concentration profiles within the central test subchannel. The radial diffusivity of mass within a subchannel and the transport of mass between subchannels were investigated. (auth)

12669 (COO-3027-12) INTERPHASE PHENOMENA AND THE CONDENSATION OF LIQUID METAL VAPORS. The Condensation Mechanism of Nitrogen Tetroxide Vapor. Larrain, J.; Bonilla, C. F. (Columbia Univ., New York (USA)). [nd]. Contract AT(11-1)-3027. 216p. Dep. NTIS $13.00.

Thesis. Submitted by J. Lorrain.

Theoretical analyses of interphase processes involving vapors and liquids are presented. Monoatomic and reacting vapors were considered in situations such as condensation, evaporation and heat transfer between the vapor and its liquid. These developments are believed to be the most accurate to date in describing such processes. The implications of the presence of diatomic and heavier molecules in liquid metal vapors in their condensation heat transfer are discussed. It is shown that some assumed detailed mechanisms of condensation of these species can explain the low experimental condensation heat transfer coefficients of liquid metals. Results of an experimental investigation of the condensation mechanism and condensation heat transfer of nitrogen tetroxide vapor are presented. From measurements of temperature profiles in the vapor near the vapor-liquid interface during condensation it was concluded that both major components of the vapor (nitrogen dioxide and nitrogen tetroxide) condense at comparable rates. This mechanism is in qualitative agreement with the experimental condensation heat transfer coefficients, which were found to be 10 to 20% higher than predicted by Nusselt's theory. This is apparently the first determination of a detailed condensation mechanism at moderate pressures where traditional methods (e.g., vacuum evaporation techniques) can not be used. (auth)

12670 (FEI-385) INVESTIGATION OF VELOCITY FIELDS AND COEFFICIENTS OF HYDRAULIC RESISTANCE IN PIPES WITH ARTIFICIAL WALL ROUGHNESS. Millionshchikov, M. D.; Subbotin, V. I.; Ibragimov, M. Kh.; Taranov, G. S.; Kobzar, L. L.; Gomonov, I. P.; Sokolovskii, A. R. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergetic-

heskij Inst.). 1973. 63p. (In Russian). Dep. NTIS (U. S. Sales Only) $5.25.

Experimental data are reported on the resistance coefficients and the velocity profile in the region of Reynolds numbers from 4×10^3 to 1×10^6. The surface roughness represents a single-thread screw with different profile forms, multithread cross screws with triangular profile, circular grooves, pyramids, and semicircular projections of different thicknesses. The hydrodynamic flow characteristics depend on the average height of the roughness elements, the dispersion of their heights, and the forms and spacings of these elements. The diversity of the variants of the roughened pipes make it possible to trace the effect of each of these factors on the flow hydrodynamics. (tr-auth)

12671 EXPERIMENTAL INVESTIGATION OF THE VISCOSITY OF CESIUM VAPOR. Vargaftik, N.B.; Tarlakov, Y.V.; Sidorov, N.I. (Moscow Aviation Institute). High Temp. 10: No. 6, 1081-1086 (July 1973).

The viscosity of superheated cesium vapor was measured in the temperature range 900–1200 °K at pressures of 0.5–2.5 bar using a straight-capillary viscometer. The experimental error was ±2.5%. A brief description of the apparatus and the measurement method is given. The results obtained are compared with the published values. (auth)

12672 NONSTATIONARY WAVES IN A TWO-PHASE FLOW. Tsiklauri, G.V. (Institute of High Temperatures, Academy of Sciences of the USSR). High Temp. 10: No. 6, 1134-1138 (July 1973).

The nonstationary flow of an underheated (saturated) fluid in pipes with heat input is analyzed. The method of characteristics is used with the assumption of thermodynamic equilibrium. It is shown that the formation of compression shocks is possible in the nonstationary expansion process. (auth)

12673 UPPER LIMIT OF CRITICAL HEAT FLOWS IN BOILING. Labuntsov, D.A. (G. M. Krzhizhanovsk Power Institute). High Temp. 10: No. 6, 1208-1210 (July 1973).

Three feasible methods for an approximate estimation of the maximum critical heat flow values for the boiling of a saturated liquid are considered and discussed. (WHK)

Materials Testing

Refer also to abstracts 13073, 14814, 15158, and 15175.

12674 (CGSB-48-GP-5) MANUAL ON INDUSTRIAL RADIOGRAPHY. Apr. 1970. 229p. Dept. of Supply and Services, Ottawa, Ont.

This manual is intended as a source of educational material for personnel seeking certification as industrial radiographers, and as a guide and reference text for educational organizations and training centers giving courses in industrial radiography. Basic mathematical and physical concepts of radiation and radiography are presented, followed by chapters on radiation safety and radiographic films and film processing. Practical information on obtaining and interpreting radiographs of welds and weldments, castings and forgings, and aircraft structure and components is included. New radiographic techniques are discussed and the importance of maintaining an accurate and complete system of records is stressed. (INIS)

12675 (HEDL-SA-615) UNDER SODIUM VIEWING. Day, C. K.; Smith, R. W. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Oct 1973. Contract AT(45-1)-2170. 21p. (CONF-731128-1). Dep. NTIS $3.25.

From IEEE ultrasonics symposium; Monterey, California, USA (5 Nov 1973).

Under sodium viewing combines some standard ultrasonic techniques with some new data processing methods to perform ranging and imaging functions in the optically opaque coolant of the Liquid Metal Fast Breeder Reactor. Pulse-echo scanning methods including both B-scan and C-scan are used in conjunction with a synthesis of these methods by a technique called ISO-SCAN. By combining depth and spatial information from the B- and C-scans, ISO-SCAN produces a 3-dimensional visualization of objects submersed in liquid sodium. Special transducers have been developed to operate in sodium at temperatures up to 550°F. This development included a process for promoting rapid wetting of the stainless steel lens of the transducer by the sodium. A lack of wetting prevents acoustic coupling between the transducer and sodium. Experiments conducted in sodium to 600°F have demonstrated the ability to locate and identify objects. (auth)

12676 (UNI-71) ULTRASONIC HOLOGRAPHY THROUGH METAL BARRIERS. Toffer, H.; Hildebrand, B. P.; Albrecht, R. W. (United Nuclear Industries, Inc., Richland, Wash. (USA); Battelle Pacific Northwest Labs., Richland, Wash. (USA); Washington Univ., Seattle (USA). Dept. of Nuclear Engineering). Oct 1973. Contract AT(45-1)-1857. 31p. (CONF-730734-1). Dep. NTIS $3.75.

From 5th international symposium on acoustic holography and imaging; Palo Alto, California, USA (18 Jul 1973).

Scanned ultrasonic holography used to retrieve information about objects located behind massive metal barriers is described. The retrieved information is contained in the characteristic interference patterns recorded as the hologram and the visual image is reconstructed from it. Particular problems associated with sound wave transmission through metal slabs, such as multiple reflections and mode conversion, were studied using holograms of point and plane wave sound sources and correlated with analytic techniques. Arising from these studies were procedures for imaging complex target configurations using a focused transducer operating in a pulse-echo mode at normal incidence with an electronically shifted reference beam. Diffusely and specularly reflecting objects were imaged through 1-, 2-, and 4-in. thick flat, and a 2-in. thick curved cylindrical surface aluminum slabs. The limitations of ultrasonic holography through material barriers and the effect of such barriers on the imaging equations were developed analytically and tested against measurements. Possible applications of the technique in the nuclear industry are considered. The potential imaging of irradiated fuel elements in metal covered storage cubicles are explored in detail. (auth)

12677 METHOD OF MAPPING RADIOACTIVITY DISTRIBUTION IN BODIES. Fronka, O.; Pavlicek, Z. Czech Patent 145,176. 15 Sep 1972. Filed date 16 Nov 1971. 2p. (In Czech).

A method is described for mapping the distribution of radioactivity in bodies based on the effects of radiation emitted by the body on a layer of exoemissive substance coated on a carrier to which the tested body is pressed. On completing the exposure, the layer is separated from the body and the exoelectron emission induced by radiation is measured using a gas counter. The duration of the exposure depends on the absolute value of the body activity. The method is well suited mainly for the determination of the distribution of low activity in the surface layers of a body. (INIS)

12678 NUCLEAR PHYSICS IN WELDING MATERIALS INSPECTION. Zitnansky, B. (Vyskumny Ustav Zvaracsky, Bratislava). Hutn. Listy; 28: No. 2, 141-143(Feb 1973). (In Slovak).

A nuclear installation is described for activation analysis that permits a wide scope of speedy, nondestructive analyses of materials. The advantages of this type of analysis are shown by the determination of fluorine in fluxes. (INIS)

Nuclear Explosions

Refer also to abstracts 12961, 12962, and 14127.

12679 (AD-762347) SCALING OF GROUND MOTIONS FROM CONTAINED EXPLOSIONS IN ROCK FOR ESTIMATING DIRECT GROUND SHOCK FROM SURFACE BURSTS ON ROCK. Hendron, A. J. Jr. Jan 1973. Contract DACA45-69-C-0100. 37p. (OMAHA-TR-15) NTIS $3.00.

A large number of motion measurements from contained explosions in various rock types are reviewed and presented. These data are interpreted in terms of dimensional analysis and other constraints necessary for dynamic consistency to yield scaling relations for estimating peak motions in various rock media from contained bursts. Suggestions are also given for estimating ground motions from direct induced ground shock resulting from a surface burst on rock. (auth)

12680 (UCRL-51465) MECHANICAL PROPERTIES OF BLAIR DOLOMITE. Heard, H. C.; Duba, A.; Abey, A. E.; Schock, R. N. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Oct 1973. Contract W-7405-eng-48. 17p. Dep. NTIS $4.00.

Pressure-volume, uniaxial stress loading to failure, uniaxial strain, and acoustic velocity determinations were made on Blair dolomite at confining pressures ranging to 3.5 GPa (Pa = Paschals where 10^5 Pa = 1 bar or 0.1 GPa = 1 kbar). The bulk modulus K, rapidly rises from an initial 10.4 GPa (at atmospheric pressure) to 102.0 GPa at 1 GPa pressure. At higher pressures, K remains essentially constant (110 GPa). The maximum volume change on loading is 3.9% at 3.5 GPa; the unloading closely follows the loading path. Comparison of uniaxial stress tests in compression to 0.7 GPa and extension to 2.1 GPa confining pressure demonstrates that the characteristic shear stress at failure as well as the transition from brittle fracture to ductile flow is strongly dependent upon both the value of the intermediate principal stress σ_2 and the rate of strain. The onset of dilatancy as determined in uniaxial compression occurs at about two-thirds of the failure stress. The uniaxial strain loading path is well below the failure envelope in

compression. In uniaxial stress loading (compression), Young's modulus (E) and shear modulus (μ) are demonstrated to be very sensitive to both confining pressure and to the level of shear stress. For example, at pressures of 0.1 MPa to 0.5 GPa, both E and μ first increase up to shear stresses of 0.05 to 0.15 GPa and then decrease at all higher stress values. These moduli are shown to be very sensitive indicators of the onset of dilatancy. Elastic moduli as derived from acoustic velocity measurements also increase with confining pressure (to 1 GPa), with the major change occurring below 0.1 GPa. All of the observations made at nonhydrostatic conditions are consistent with the closure of pre-existing cracks at low pressures and low shear stresses followed by an increasing rate of crack growth as stress is increased, even at the higher confining pressures. However, some cracks, which would normally close with hydrostatic pressure, remain open under uniaxial stress loading at similar mean pressures. (auth)

12681 (UCRL-75148) ELECTROMAGNETIC PULSE SOURCE CHARACTERISTICS EXPERIMENT ON AN UNDERGROUND NUCLEAR EVENT. Knapp, M. W.; Bailey, N. D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 22 Oct 1973. 16p. (CONF-730935-4). Dep. NTIS $3.00.

From EMP technical meeting; Kirtland AFB, New Mexico, USA (25 Sep 1973).

Under sponsorship of the Advanced Research Projects Agency, the Lawrence Livermore Laboratory conducted an EMP experiment in conjunction with an underground nuclear event. The purpose of the overall study of which this experiment was a part was to document the characteristics of EMP signals generated by various underground nuclear events to provide checks for theoretical models under development. A major goal was to establish how a specific event configuration affects the signals generated. For this experiment, two separate EMP source mechanisms were considered: that due to an asymmetric gamma ray distribution resulting from shielding and configuration constraints in the vicinity of the device and that due to current induced on the line-of-sight pipe. The instrumentation was not ideally located to sort out the two mechanisms because of significant differences between the planned and as-fired configuration. Nevertheless, signals characteristic of the two mechanisms seem to be apparent in the data. An impulsive (10 MHz) component of the signal is probably a result of the asymmetric gamma distribution. A ringing component (1 MHz) has been attributed to currents on the line-of-sight pipe. (auth)

12682 (USGS-474-176) EXPLOSION-INDUCED FRACTURES OF SELECTED ANNOUNCED UNDERGROUND NUCLEAR TESTS, YUCCA FLAT, NEVADA TEST SITE, NEVADA, JANUARY THROUGH DECEMBER 1972. Steele, S. G.; Snyder, R. P. (Geological Survey, Denver, Colo. (USA)). Nov. 1973. Contract AT(29-2)-474. 38p. (NTS-245). Dep. NTIS $4.00.

During the period from Jan. through Dec. 1972, personnel of the U. S. Geological Survey mapped the surface effects produced by six announced underground nuclear tests conducted in Areas 2, 3, and 7, Yucca Flat, Nevada Test Site. Five tests resulted in collapse sinks and mappable surface effects. Faults as well as fractures on which previous explosion-induced movement had been noted were reactivated by some tests. Some tests had neither surface fractures nor collapse features. (auth)

Protective Structures and Equipment

12683 PROTECTIVE CLOTHING EQUIPMENT FOR OPERATORS WORKING IN SEALED ENCLOSURES. (to La Calhene). French Patent 2,133,271. 15 Apr 1971. 14p. (In French).

Protective clothing equipment for operators working in sealed enclosures that are pressurized or depressurized in relation to the atmosphere is presented. The equipment is of the type in which the sealed clothing forms an integral part of the wall of the enclosure, a transparent hood protecting the head of the operator and interchangeable gloves being provided. The special feature of the equipment is that the sealed clothing is provided with two walls, an inner wall in contact with the operator and an outer wall common with that of the enclosure, the two walls defining mutually an inflatable zone. The inner wall is provided with a nonsealed part enabling a permanent leak from the inflatable zone towards the inside of the protective clothing to be obtained and at least one point on the insulating clothing situated around the waist or in the back part with means envisaged for regulating the leak rate from the inside of the suit to the surrounding atmosphere. (FR)

12684 PROTECTIVE EQUIPMENT FOR WORK IN NOXIOUS ATMOSPHERES. Savornin, J. (to Commissariat a l'Energie Atomique). French Patent 2,146,158. 22 Jul 1971. 7p. (In French).

Protective equipment for work in a contaminated atmosphere (tritium) is described. It consists of a protective suit, at least half of which is made of flexible material, and a fresh air supply tube feeding this suit, the stale air being extracted from the suit by a tube. A special feature of the assembly is an extraction part situated inside the suit. This part is connected to the tube by a sealed channel which traverses the wall of the suit. (FR)

Safety Engineering

12685 (AEC-tr-7501) STUDY CONCERNING THE FIRE SUPPRESSION IN LIQUID SODIUM. Huber, F.; Menzenhauer, P.; Peppler, W.; Till, W. Translated from KFK Nachr.; 4: No. 3, 9-13(1972). 10p. Dep. NTIS $3.00.

The operation of sodium plants involves a risk of liquid-metal fires as a result of leaks. This applies to reactors as well as prototype circulation systems. Results of experiments using a collecting seat and a proper cover for containing sodium fires are described. (TFD)

12686 PROBLEMS AND TECHNIQUES FOR REMOVAL OF RADON AND RADON-DAUGHTER PRODUCTS FROM MINE ATMOSPHERES. Goodwin, A. (Bureau of Mines, Washington, DC). Nucl. Safety; 14: No. 6, 643-650(1973).

Ventilation with fresh air has been, and will continue to be, the primary solution for controlling radon and radon-daughter activity in mines. However, procedures to make the ventilation process more effective and to reduce contamination have been proposed, such as sealing off of old workings, the use of coatings to reduce radon inflow, and mine pressurization. Air-cleaning techniques have proved successful in certain applications. For example, radon daughters can be removed by mechanical filtering and by electrostatic precipitation methods, both of which remove condensation nuclei to which radon daughters become attached. The radon gas that passes through continues to decay, but, in the absence of condensation nuclei, the daughters have large diffusion lengths and are trapped on the walls of air courses, thus inhibiting their growth. Radon gas has been successfully removed from air, although there are no known reports of this having been done in operating mines. It has been captured on activated charcoal and silica gel and chemically removed by reacting with a halogen fluoride and a metal fluoride. (auth)

ENVIRONMENTAL AND EARTH SCIENCES

Minerals and Ores

12687 (JINR-P13-7363) SEARCH FOR SPONTANEOUSLY FISSIONING EMITTERS IN THERMAL BRINES OF CHELEKEN. Chuburkov, Yu. T.; Maslov, O. D.; Lebedev, L. M.; Shatalov, V. V.; Smirnov, V. Yu.; Chuburkova, I. I.; Petrov, D. V.; Makedonskaya, A. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1973. 16p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

A number of samples from peninsula Cheleken are selected and measured. The detected impulses from the fission fragments cannot be explained by spontaneous fission of uranium contained in it. Low absolute value of the effect does not allow, for the present, the conclusions on the emitter nature to be made. (auth)

12688 STUDY OF URANIUM ORES USING THERMAL ANALYSIS. Chantret, F. (CEN, Fontenay-aux-Roses, France). Bull. Inform. Sci. Tech. (Paris); No. 181, 25-31(May 1973). (In French).

The usefulness of thermal analysis methods is discussed. Some examples are given of their applications to the study of minerals and uraniferous ores. The usefulness of differential thermal analysis in conjunction with the continuous analysis of SO_2 and CO_2 for the determining of phases that exhibited reducing conditions during the formation of certain sedimentary deposits is emphasized. (FR)

12689 BEHAVIOR OF URANIUM AND THORIUM ISOTOPES IN THE SYSTEM CRYSTALLINE ROCKS–SURFACE WATERS UNDER CONDITIONS OF A COLD HUMID CLIMATE. Titaeva, N. A.; Filonov, V. A.; Ovchenkov, V. Ya.; Veksler, T. I.; Orlova, A. V.; Tyrina, A. S. (Moscow State Univ.). Geokhimiya; No. 10, 1522-1528(Oct 1973). (In Russian).

Results of the determination of uranium and thorium and of their isotopic composition in rocks and surface waters of the western part of the Man-Khambo granite massif (Ural region near the Pole) are given. With the aid of isotopic ratios it was found that even under conditions of a cold humid climate an active interaction of rocks and surface waters occurs in consequence of which the latter are enriched in uranium and thorium. Uranium passes into the liquid phase approximately twice as intensely as thorium. The possibility of using the series $^{232}Th \rightarrow {}^{228}Ra \ldots \rightarrow {}^{228}Th$ during investigation of recent geochemical processes is discussed. (auth)

12690 URANIUM IN INTERSTITIAL WATERS OF MARINE AND OCEANIC SEDIMENTS. Baturin, G. N.; Kochenov, A. V. (Inst. of Oceanology, Moscow). Geokhimiya; No. 10, 1529-1536 (Oct 1973). (In Russian).

Uranium content in interstitial waters from sediments of the Atlantic and Pacific Oceans and the Black Sea varies from 1.3 to 650×10^{-6} g/l, which confirms the relative diagenetic uranium mobility. To the factors determining uranium content in interstitial waters belong: pH, Eh, the U and C_{org} content in sediments, the content of dissolved organic matters, and CO_2 in interstitial waters. The dependence of uranium content in interstitial waters upon C_{org} in sediments permits the assumption that some of the dissolved uranium is present in the form of metalloorganic complexes. (auth)

Radioactive Effluents

Refer also to abstracts 12751, 12813, 12819, 14610, 14742, and 15120.

12691 (BNL-18359) ENVIRONMENTAL RADIATION DOSE CRITERIA AND ASSESSMENT: PATHWAY MODELING AND SURVEILLANCE. Hull, A. P. (Brookhaven National Lab., Upton, N.Y. (USA)). 1973. 7p. (CONF-731112-16). Dep. NTIS $3.00.

From nuclear science symposium; San Francisco, California, USA (14 Nov 1973).

The controversy in recent years over the extent of the risk to the public from environmental radioactivity attributable to nuclear facilities (in particular nuclear power plants and fuel reprocessing facilities) has resulted in a lowering of previously acceptable environmental radiation levels. The proposal by the AEC to limit effluents from light-water-cooled nuclear reactors so that the exposure of any individual in the public would not exceed 5 mR/yr, and the pronouncement by the BEIR Committee that the current environmental radiation protection guides are unnecessarily high, are illustrative. In turn the AEC has issued a Safety Guide calling for considerable refinement in the measuring and reporting of effluents from nuclear power plants, and has only recently issued a counterpart dealing with the measuring and reporting of radioactivity in the environs of nuclear power plants. The EPA has also recently issued a guide for the surveillance of environmental radioactivity. Currently, power reactor operators are being required by the AEC Regulatory Staff to conduct detailed, sensitive environmental surveillance. Much of this appears to be based on extremely conservative assumptions throughout, including dose-effect relationships, exposure situations, pathway models, reconcentration factors and intakes, which cannot be substantiated when examined in the light of current experience in the vicinity of existing power reactors. The expenditures occasioned by the required additional in-plant features necessary to meet the currently proposed effluent release criteria appear difficult to justify on a reasonable basis. Environmental monitoring at the proposed concentration limits appear even more excessive in terms of dollars per man-rem of potential dose commitment. (auth)

12692 (BNWL-B-296) NATURE OF ACTINIDE SPECIES RETAINED BY SEDIMENTS AT HANFORD. Interim Progress Report. Swanson, J. L. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Aug 1973. Contract AT(45-1)-1830. 25p. Dep. NTIS $3.25.

Waste solutions containing low levels of actinides were formerly discharged to the soil under controlled conditions on the Hanford reservation. A knowledge of the nature of the species in which the actinides are present in the soil is important for deciding what course of action should be taken in the future. The results obtained in FY-1973 of a recently initiated program designed to investigate the nature of the actinide species retained by soils. The samples were obtained from the 216-Z-9 trench, which received waste streams from the Recuplex scrap recovery process from 1955 to 1962. The approach taken was to determine the leach behavior of the Pu and Am present in various portions of these samples under a variety of conditions and then, by comparison with the behavior of known species under the same conditions, infer the nature of the species present in the soil. A program to develop leach procedures appropriate to characterizing the behavior of different actinide species retained by soils is in progress. (CH)

12693 (HW-24548) PRELIMINARY STUDIES OF PLUTONIUM ADSORPTION IN HANFORD SOIL. Rhodes, D. W. (Douglas Aircraft Co., Inc., Tulsa, Okla. (USA)). 29 May 1952. Contract W-31-109-eng-52. 22p. Dep. NTIS $3.25.

Some preliminary studies of the adsorption of Pu from aqueous solutions by soil indicate that at concentrations of <100,000 d/m/ml and a neutral or slightly acid pH, Pu is adsorbed very effectively (>99%). The greater portion of the Pu is adsorbed almost instantaneously and seems to be adsorbed just as effectively from a solution containing as much as 82 gm/l of salts as from distilled water. Plutonium is adsorbed most effectively by the soil constituents having a high specific surface and a high cation exchange capacity. The results in general indicate that an exchange reaction is probably the predominate mechanism involved in the removal of Pu from solution by soil. (auth)

12694 (HW-74307-12) RADIOLOGICAL STATUS OF THE HANFORD ENVIRONS FOR DECEMBER 1962. Foster, R. F. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 10 Jan 1963. 7p. Dep. NTIS $3.00.

The following data pertaining to the Hanford environs for December, 1962, are tabulated: percentage of reactor effluents in the Columbia River; estimated dose in millirem to the gastrointestinal tract from drinking water; rate of transport of ^{32}P, ^{51}Cr, ^{65}Zn, ^{76}As, and ^{239}Np by the Columbia River; concentration of ^{32}P in whitefish; separations facilities stack emissions of ^{131}I; concentrations of ^{131}I in air and milk; beta activity in air; and chemical characteristics of Columbia River water. (HLW)

12695 REGULATIONS FOR THE MEASUREMENT AND CONTROL OF RADIOACTIVE LIQUID EFFLUENTS FROM NUCLEAR POWER PLANTS WITH LIGHT-WATER REACTORS. Bundesgesundheitsblatt; 16: No. 15/16, 231(1973). (In German).

Within the framework of the licensing procedure for nuclear power plants, a standard maximum annual radioactivity has been established limiting the discharge of radioactive liquid effluents in compliance with the First Radiation Protection Ordnance. The most important physical data and the required detection limits are given for those fission products that are essential for the evaluation of environmental exposure. (GE)

Radioactivity Monitoring and Transport

Refer also to abstracts 12694, 12741, and 14737.

12696 (ANL-8060(Pt. 2), pp 278-288) RADIOLOGICAL ENVIRONMENTAL SURVEY AT EBR-II. Oltman, B. G.; Eckerman, K.; Gold, R.; Strash, A. M. 1973.

Radiological and Environmental Research Division annual report, July 1972-June 1973.

Absolute environmental gamma and meson dose rates were determined from measurements made in the vicinity of EBR-II. The detector used for the measurements was a 5-in. diameter sphere of liquid organic scintillator. Fourteen measurements were made at radial distances of up to 5 miles from the EBR-II effluent stack. The average external gamma and meson dose rates determined were 6.0 μrad/hr and 4.5 μrad/hr, respectively. Soil samples obtained at each of the measurement sites were later analyzed for gamma emitters and for plutonium content. Other than naturally occurring radioactivity, only ^{137}Cs and ^{125}Sb seemed to be present in statistically significant amounts. No plutonium deposition pattern could be constructed from the limited number of analyses done. (auth)

12697 (BNWL-B-228) ENVIRONMENTAL STATUS OF THE HANFORD RESERVATION FOR 1971. Bramson, P. E.; Corley, J. P. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Sep 1972. Contract AT(45-1)-1830. 85p. Dep. NTIS $6.25.

Data are presented on the radioactivity in environmental samples collected from various locations within the Hanford plant boundaries during 1971. Data are included on: the total α activity and content of ^{90}Sr and tritium in samples of Columbia River water; the total β activity in samples of drinking water and estimates of the radiation dose to the gastrointestinal tract of man ingesting the water; the α, β, and γ activity in surface waters; the total γ activity and content of ^{90}Sr, ^{239}Pu, ^{241}Am, ^{24}Na, ^{32}P, ^{58}Co, ^{60}Co, ^{65}Zn, and ^{137}Cs in tissues from waterfowl, gamebirds, deer, and small mammals feeding on the area; the total α and β activity and content of ^{131}I in surface air; and the radioactivity in air filters and samples of vegetation. (CH)

12698 (BNWL-C-96) ENVIRONMENTAL STATUS OF THE HANFORD RESERVATION FOR 1970. Bramson, P. E. (ed.). (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jun 1972. 102p. Dep. NTIS $7.25.

Data are summarized on the radioactivity in environmental samples collected from various locations within the Hanford plant boundaries during 1970. Data are included on the content of ^{90}Sr, ^{32}P, ^{46}Sc, ^{51}Cr, ^{65}Zn, ^{131}I, ^{24}Na, and tritium in samples of water from the Columbia River; the total β activity in samples of drinking water; the total α and β activity in samples of surface waters; the radioactivity in tissue samples from waterfowl, game birds, deer, and small mammals feeding on the area; the total β activity and ^{131}I content in samples of surface air; and the total α, β, and γ activity in samples of air filters from various locations. (CH)

12699 (BNWL-CC-574) EARTH SCIENCES WASTE DISPOSAL INVESTIGATIONS, JULY-DECEMBER 1965. Eliason, J. R. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Apr 1966. 20p. Dep. NTIS $3.00.

The Hanford Project has over 500 wells which are used for the surveillance of radionuclides in the ground resulting from waste disposal. Wells are located at disposal sites to monitor the migration of radionuclides in the soil and to determine when a disposal facility is to be abandoned. Outside of the immediate disposal areas, wells are sampled to determine the movement of contaminants in the ground water zone. The spread of wastes in unconfined ground water aquifers is followed by routine sampling, and the confined aquifers in the area are sampled frequently where possible. Maps of gross β and tritium concentrations in the ground water are presented to define contamination spread from the disposal areas during the last six months of 1965. (auth)

12700 (BNWL-CC-1850) ENVIRONMENTAL STATUS OF THE HANFORD RESERVATION FOR JANUARY-JUNE 1968. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Sep 1968. 68p. Dep. NTIS $5.50.

Data are presented on the radioactivity in environmental samples collected within the Hanford plant boundaries during the first half of 1968. Data are included on the total α activity, total β activity and content of ^{90}Sr and tritium in samples of Columbia River water; the total β activity in samples of drinking water; the content of ^{51}Cr, ^{95}Zr-Nb, ^{103}Ru, ^{106}Ru, ^{134}Cs, ^{137}Cs, and ^{144}Ce-Pr in samples of surface waters; the total β activity and content of ^{131}I in samples of surface air; the total α, β, and γ activity in samples of air filters; and the estimated external radiation exposure rates to personnel. Routine monitoring surveys of plant roads with a γ spectrometer were carried out. Increases in atmospheric β activity were related to increased fallout deposition. A temporary increase in atmospheric ^{131}I concentrations was related to release in gaseous wastes. (CH)

12701 (BNWL-CC-2026) ENVIRONMENTAL STATUS OF THE HANFORD RESERVATION FOR JULY-DECEMBER 1968. Wooldridge, C. B. (ed.). (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 17 Apr 1969. 84p. Dep. NTIS $6.25.

Data are presented on the radioactivity in environmental samples collected within the Hanford plant boundaries during the last six months of 1968. Data are included on the total α activity, total β activity, and content of ^{90}Sr and tritium in samples of Columbia River water; the total β activity in samples of drinking water; the content of ^{51}Cr, ^{65}Zn, ^{125}Sb, ^{131}I, ^{134}Cs, and ^{137}Cs in samples of surface waters; the content of ^{32}P, ^{65}Zn, ^{137}Cs, and ^{137m}Ba in tissues of game birds feeding on the area; the total β activity and ^{131}I content of samples of surface air; and the total α activity, β activity, and γ activity in samples of air filters. Estimates were made of the average external γ exposure rates of personnel. (CH)

12702 (BNWL-CC-2478) ENVIRONMENTAL STATUS OF THE HANFORD RESERVATION FOR JANUARY-JUNE 1969. Wilson, C. B.; Essig, T. H. (eds.). (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 7 Apr 1970. 94p. Dep. NTIS $6.75.

Data are presented on the radioactivity in environmental samples collected within the Hanford plant boundaries during the first six months of 1969. Data are included on the total β activity and content of ^{90}Sr and tritium in samples of Columbia River water; the total β activity in samples of drinking water; the total α and β activity and content of ^{137}Cs, ^{51}Cr, and ^{65}Zn in samples of surface waters; the content of ^{32}P, ^{40}K, ^{134}Cs, ^{137}Cs, and ^{65}Zn in the tissues of game birds feeding on the area; the total β activity and content of ^{131}I in samples of surface air; the total α, total β, and total γ activity and content of ^{95}Zr-Nb, ^{106}Ru, ^{131}I, ^{137}Cs, ^{140}Ba, and ^{144}Ce in samples of air filters; the total α and total β activity and content of ^{137}Cs and ^{144}Ce in samples of vegetation; and results of aerial surveys of γ activity conducted at an altitude of 500 feet. Estimates were made of the average external γ exposure rates of personnel. Increased β activity in the atmosphere was due to fallout. (CH)

12703 (BNWL-CC-2583) ENVIRONMENTAL STATUS OF THE HANFORD RESERVATION FOR JULY-DECEMBER 1969. Wilson, C. B.; Essig, T. H. (eds.). (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 26 May 1970. 80p. Dep. NTIS $6.00.

Data are reported on the radioactivity of environmental samples collected from locations within the Hanford plant boundaries during the last six months of 1969. Data are included on: the total α activity and content of ^{90}Sr and tritium in samples of Columbia River water; the total β activity of samples of drinking water; the total α, β, and γ activity of samples of surface waters; the total β activity and ^{131}I content of samples of surface air; and the total α, β, and γ activity and content of ^{95}Zr, ^{106}Ru, ^{134}Cs, ^{137}Cs, ^{140}Ba, ^{144}Ce, ^{238}Pu, ^{239}Pu, and ^{240}Pu of air filter samples. Estimates were made of the average external γ radiation exposure rates of personnel. (CH)

12704 (HASL-278) FALLOUT PROGRAM. Quarterly Summary Report, September 1, 1973-December 1, 1973. Hardy, E. P. Jr. (USAEC Health and Safety Lab., New York). 1 Jan 1974. 171p. Dep. NTIS $7.60.

Current data are presented from the HASL Fallout Program and the Radiological and Environmental Research Division at Argonne National Laboratory. The initial section consists of interpretive reports and notes on the dose to man from ^{239}Pu fallout; the respirable fraction of ^{90}Sr, ^{239}Pu, and stable lead in surface air; ^{137}Cs and ^{90}Sr in bone; the quality of 1972 surface air analyses, and quality control of 1973 samples of fallout, diet, tap water, and human bone. Subsequent sections include tabulations of radionuclide levels in fallout, surface air, stratospheric air, milk, diet, and tap water. A bibliography of recent publications related to radionuclide studies is also presented. (auth)

12705 (HASL-278(App.)) APPENDIX TO FALLOUT PROGRAM. Quarterly Summary Report, September 1, 1973-December 1, 1973. Hardy, E. P. Jr. (USAEC Health and Safety Lab., New York). 1 Jan 1974. 460p. Dep. NTIS $10.60.

Data are tabulated on the content of fallout in samples collected from September 1, 1973 through December 1, 1973. Data are included on ^{90}Sr and ^{89}Sr in monthly deposition at world land sites; the content of various fallout radionuclides and Pb in surface air; and the content of ^{89}Sr and ^{90}Sr in milk and tap water. A table of conversion factors is included. (CH)

12706 (HW-8674) SPECULATIONS ON LONG-RANGE WASTE DISPOSAL HAZARDS. Parker, H. M. (Hanford Works, Richland, Wash. (USA)). 26 Jan 1948. Contract W-31-109-eng-52. 11p. Dep. NTIS $3.00.

Results are reported from a 1948 survey on the safety of liquid radioactive waste disposal practices at the Hanford Works. The disposition of underground wastes was studied during a one-year

period to determine if there was a significant risk of contamination of drinking water supplies and to the Columbia River and if additional wastes could be released to the disposal area. Drill cores from a number of test wells were examined for the presence of Pu, U, and fission products. The geology and hydrology of the area were reviewed, with emphasis on ground water flow patterns. It was concluded that the disposal procedures in use could be continued for a period of 50 years without danger of contamination of water resources in the area. (CH)

12707 (HW-36411) EARTH SCIENCES WASTE DISPOSAL MONITORING ACTIVITIES, MARCH 1955. Brown, R. E.; Holtzinger, K. R.; Raymond, J. R. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 15 Apr 1955. Contract W-31-109-eng-52. 13p. Dep. NTIS $3.00.

Data are presented on the radioactivity in samples of ground water collected from wells at radioactive waste disposal areas at Hanford during the first three months of 1955. Water samples were also analyzed for non-radioactive Na^+ and NO_3^- ions as indicators of the direction of movement of radioactive wastes through the soil. (CH)

12708 (HW-43148) EARTH SCIENCES' WASTE DISPOSAL MONITORING ACTIVITIES SUMMARY, DECEMBER 1955. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 1955. Contract W-31-109-Eng-52. 14p. Dep. NTIS $3.00.

Data are reported on the total α activity and gross β activity in samples of ground water collected from test wells at Hanford during December 1955. The sorptive properties of Hanford soils for ^{137}Cs and ^{90}Sr were studied. (CH)

12709 (HW-65464-RD) CHEMICAL EFFLUENTS TECHNOLOGY WASTE DISPOSAL INVESTIGATIONS, JANUARY, FEBRUARY, MARCH 1960. Haney, W. A. (ed.). (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 19 May 1960. Contract AT(45-1)-1350. 17p. Dep. NTIS $3.00

Data are reported on the total α activity, gross β activity, and content of ^{106}Ru, ^{137}Co, ^{144}Ce, ^{147}Pm, ^{90}Sr, ^{125}Sb, ^{95}Zr, ^{95}Nb, ^{60}Co, and ^{127}Te in samples of ground water collected from test wells at Hanford during January, February, and March 1960. Essentially all the β activity was due to the presence of ^{106}Ru and its daughter ^{106}Rh. Methods for leak testing around underground waste storage tanks and for testing particle deposition in sampling lines were evaluated. A new contour map of ground water of the Hanford plant area was constructed from data obtained from a representative pattern of wells. (CH)

12710 (HW-67753-RD) CHEMICAL EFFLUENTS TECHNOLOGY WASTE DISPOSAL INVESTIGATIONS, JULY, AUGUST, SEPTEMBER 1960. Haney, W. A. (ed.). (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 9 Dec 1960. Contract AT(45-1)-1350. 20p. Dep. NTIS $3.00.

Data are reported on the total α activity, gross β activity, and content of ^{106}Ru, ^{137}Co, ^{144}Ce, ^{147}Pm, ^{90}Sr, ^{125}Sb, ^{95}Zr, ^{95}Nb, ^{60}Co, and ^{127}Te in samples of ground water collected from test wells at Hanford during July, August, and September 1960. The removal of fission products from waste solutions by Hanford soils, methods for the treatment and disposal of wastes resulting from the decontamination of NPR coolant loops, and the effects of the size of particles in gaseous effluent streams on particle deposition and retention on conduits were studied. (CH)

12711 (HW-74307-9) RADIOLOGICAL STATUS OF THE HANFORD ENVIRONS FOR SEPTEMBER 1962. Foster, R. F. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 12 Oct 1962. Contract AT(45-1)-1350. 8p. Dep. NTIS $3.00.

Radiological data pertaining to the Hanford environs for September 1962 are summarized. Data are included on the estimated rate of transport of ^{32}P, ^{51}Cr, ^{65}Zn, ^{76}As, and ^{239}Np by the Columbia River; the estimated radiation dose to the gastrointestinal tract of the human population from drinking water; and the content of ^{131}I in surface air and milk samples collected in the area in relation to emission in stock effluents and content of fallout deposits. (CH)

12712 (HW-74307-10) RADIOLOGICAL STATUS OF THE HANFORD ENVIRONS FOR OCTOBER 1962. Foster, R. F. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 12 Nov 1962. Contract AT(45-1)-1350. 8p. Dep. NTIS $3.00.

Radiological data pertaining to the Hanford environs for October 1962 are summarized. Data are included on the estimated rate of transport of ^{32}P, ^{51}Cr, ^{65}Zn, ^{76}As, and ^{239}Np by the Columbia River; the estimated radiation dose to the gastrointestinal tract of the human population from drinking water, and the content of ^{131}I in surface air and milk samples collected in the area in relation to emission in stack effluents and content of fallout deposits. (CH)

12713 (HW-74536) FISSION PRODUCT TRITIUM IN SEPARATIONS WASTES AND IN THE GROUND WATER. Haney, W. A.; Brown, D. J.; Reisenauer, A. E. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 1 Aug 1962. Contract AT(45-1)-1350. 13p. Dep. NTIS $3.00.

Analyses of composited waste samples from the Purex and Redox separations plants indicate that about 47 to 64 per cent of the theoretical quantity of fission product tritium entering the plants is discharged to ground in process waste streams. Although a precise material balance could not be calculated because of insufficient data, most of the remaining 36 to 53% of charged fission product tritium was believed to be in a gas phase, which was released to the atmosphere, and in high level liquid wastes, which were stored in underground tanks. Ground water contamination patterns based on tritium concentrations were similar to those based on gross beta emitter and nitrate ion concentrations. The comparatively rapid movement of tritium in the ground water assisted in defining the preferential paths which other radionuclides may later follow. Tritium concentrations exceeding the recommended maximum concentrations in drinking water for continuous non-occupational exposure, 1×10^{-3} $\mu c/cc$ [3], were observed in monitoring wells located up to six miles southeast of the 200-East Area. (auth)

12714 (HW-80909) CHEMICAL EFFLUENTS TECHNOLOGY WASTE DISPOSAL INVESTIGATIONS, JULY–DECEMBER 1963. The Movement of Contaminated Ground Water from the 200 Areas to the Columbia River. Brown, D. J.; Haney, W. A. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 18 Feb 1964. Contract AT(45-1)-1350. 17p. Dep. NTIS $3.00.

The history and current status of low and intermediate-level radioactive liquid waste disposal practices in the 200 Areas at Hanford, and the ground-water monitoring results, continue to attest to the safety and practicality of ground disposal operations. An average travel time of from 7 to 8 years is estimated for ^{106}Ru contamination in the ground water to move from the Purex Plant site southeast to the Columbia River. A period of time only slightly less, 6 to 7 years, is indicated for tritium following the same path. These travel periods will result in less than one percent of the ruthenium and about 70 percent of the tritium entering the ground water beneath Purex Plant cribs reaching the Columbia River. Tritium concentrations in test wells adjacent to the river may soon be more than an order of magnitude greater than the present background concentration in river water. Ruthenium-106 concentrations in test wells will be detectable but, due to decay and quantity discharged, will be several orders of magnitude below the recommended exposure limit for the population at large. It was concluded that neither radionuclide would affect measurably the exposure to downstream water users. (auth)

12715 (RT/PROT-(73)13) BEHAVIOR OF RADIOIODINE IN THE ENVIRONMENT AND IN MAN. Breuer, F.; De Bortoli, M. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 28 May 1973. 81p. (CONF-711082-1). Dep. NTIS (U.S. Sales Only) $6.25.

From Italian Association for Health Physics and Protection Against Radiation meeting; Rome, Italy (5 Oct 1971).

A collection of data and information is presented for the use of those who have the task of evaluating the consequences of radioiodine releases to the atmosphere. Iodine-131, ^{132}I, ^{133}I, ^{134}I, and ^{135}I produced in the fission of ^{235}U are discussed. Data are included on the physico-chemical state of radioiodine; the different sources (fallout and nuclear plants); on the methods for its removal from air; on the mechanisms and parameters of interest in the deposition from air onto vegetation (dry and wet deposition) and the successive depletion; on the radioiodine transfer from grass to milk; and on metabolism in the adult and in the child from a dynamical point of view and in relation to the stable iodine intake. The most practical and useful data for radiation protection purposes are derived, for chronic as well as for acute contamination situations; for the latter the administration of stable iodine to reduce the dose is also considered. (129 references) (auth)

12716 RADIOECOLOGY. Klechkovskii, V. M.; Polikarpov, G. G.; Aleksakhin, R. M. (eds.). New York; John Wiley and Sons, Inc. (1973). 381p. $35.00.

Translation of Radioekologiya by N. Kaner and H. Mills.

Separate abstracts were prepared for the 17 chapters of the book. In addition, there is an introduction in which the general principles of radioecology are discussed. (HLW)

For abstracts of individual chapters see: 12717–12720, 12722–12724, 12727–12729, 12733–12737, 12741, and 13015.

12717 ARRIVAL AND DISTRIBUTION OF RADIOACTIVE PRODUCTS OF NUCLEAR EXPLOSIONS ON THE EARTH'S SURFACE. Pavlotskaya, F. I. pp 30-68 of Radioecology. Klechkovskii, V. M. (ed.). New York; John Wiley and Sons, Inc. (1973).

A literature review is presented of global radioactive fallout. Graphs are presented to show intensity of yearly ^{90}Sr fallout in various countries of the northern and southern hemispheres and a table is presented to show ratios of ^{90}Sr and ^{137}Cs concentrations in fallout during 1958 to 1966. Topics discussed are: latitudinal effect and seasonality in the fallout of nuclear explosion products; ratios of individual radionuclides in fallout and the residence time of explosion products in the stratosphere; fallout of radioactive fission products from the troposphere; contents of fission products in the soil cover in the northern and southern hemispheres; distribution of radionuclides in soils; and accumulation rates and elimination of radioactive fission products from surface soil horizons. (181 references) (HLW)

12718 LANDSCAPE-GEOCHEMICAL ASPECTS OF STRONTIUM-90 MIGRATION. Tyuryukanova, E. B. pp 69-77 of Radioecology. Klechkovskii, V. M. (ed.). New York; John Wiley and Sons, Inc. (1973).

A review of studies on ^{90}Sr migration is presented. The distribution of ^{90}Sr in the bogged soils of Polysye forest zones was related to the distribution of Fe, while in the steppe zone it was related to the distribution of Ca and stable Sr. The influence of various environmental factors such as runoff direction, shape of depression, exposure, and vegetation on ^{90}Sr migration is discussed. The distribution of ^{90}Sr in root systems and aerial parts of plants is discussed and a table is presented to show ^{90}Sr concentrations in lichens, mosses, grasses, and other plants. Other topics discussed are effects of physicochemical properties of soils on migration and distribution of ^{90}Sr and ^{90}Sr concentrations in humid (forest) regions and arid (steppe) zones. (HLW)

12719 RADIONUCLIDE MIGRATION IN FOREST BIOGEOCENOSES. Aleksakhin, R. M.; Tikhomirov, F. A. pp 126-140 of Radioecology. Klechkovskii, V. M. (ed.). New York; John Wiley and Sons, Inc. (1973).

Radionuclide migration and circulation in forest cenoses are reviewed. Some topics discussed are: deposition of radioactive aerosols from nuclear weapons tests and radionuclides discharged from the stacks of nuclear enterprises; fate of radioactive particles deposited from air onto soil-plant cover; effects of particle size, topographical and meteorological conditions, and type of plant cover on horizontal transport of radioactive particles; filtering effect of vegetation on vertical transport of radioactive particles; effects of meteorological conditions and plant characteristics on primary interception by plant cover of radioactive particles; radiation damage to coniferous forests in comparison to deciduous forests; accummulation of radionuclides by forest vegetation from soil; and model experiments on migration of ^{134}Cs and ^{137}Cs in forest stands. (HLW)

12720 CHEMICAL ASPECTS OF MARINE RADIOECOLOGY. Popov, N. I. pp 338-346 of Radioecology. Klechkovskii, V. M. (ed.). New York; John Wiley and Sons, Inc. (1973).

The chemical aspects of marine radioecology are reviewed. Some topics discussed are: chemical composition of natural seawater; chemical behavior of artificial and natural isotopes; insulation of radioactive products of nuclear explosions by inclusion within microscopic particles of refractory material; fractionation of radioisotopes of rare earth elements in the ocean; use of artificial models for radioecological studies; chemical nature of atmospheric aerosols; buildup factors for radioisotopes in living organisms; hydrolysis of radioactive compounds; and polymerization processes. (HLW)

Atmosphere

12721 (UCRL-75238) COMPUTER-CONTROLLED SAMPLING SYSTEM FOR AIRBORNE RADIONUCLIDES. Koval, J. S.; Reichman, J. M.; Fry, C. O. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 26 Nov 1973. 10p. (CONF-731112-17). Dep. NTIS $3.00.

From nuclear science symposium; San Francisco, California, USA (14 Nov 1973).

A computer-controlled air sampling system has been designed and is presently being constructed. The self-contained, mobile system will collect and record data from eight meteorological sensors. This information will be used in the study of resuspended airborne activity. Air sampler operation will be based on comparisons between the meteorological data and the sampling criteria selected by the operator at the beginning of the run. Correlations between meteorological parameters and resuspension will be used to develop a predictive model. A description of system hardware and a discussion of the software concept are included. (auth)

Soil

12722 BEHAVIOR OF NATURAL RADIONUCLIDES IN SOILS. Baranov, V. I.; Morozova, N. G. pp 3-29 of Radioecology. Klechkovskii, V. M. (ed.). New York; John Wiley and Sons, Inc. (1973).

Natural radioactivity of soils is reviewed with emphasis on the geochemical aspects of the radioactivity. Tables are presented to show concentration of naturally radioactive U, Ra, Th, and K in soils of various countries and in various types of soils in the USSR. The concentration and distribution of natural radionuclides in major soils of some soil-climatic zones of the USSR are discussed. Radiogeological soil maps are considered along with their use in establishment of the general behavior of radionuclides in the planetary soil cover and determination of the role played by the soil-forming process in the geochemistry of natural radionuclides. (76 references) (HLW)

12723 BEHAVIOR OF STRONTIUM-90 AND CESIUM-137 IN SOILS. Polyakov, Yu. A.; Kader, G. M.; Krinitskii, V. V. pp 78-102 of Radioecology. Klechkovskii, V. M. (ed.). New York; John Wiley and Sons, Inc. (1973).

The forms of ^{90}Sr and ^{137}Cs compounds in soils and the impact on the behavior of these nuclides of the water factor, absorption capacity, complex formers, diffusion, and ion exchange are reviewed. Other topics discussed are energy characteristics of ion exchange reactions of the analog element, ^{90}Sr and ^{137}Cs discrimination in different stages of the ecological cycle, effects of various cations, significance of complexants, field determination of diffusion coefficients, exchange of Sr and Ca ions in soils and clays, and exchange sorption of Cs^{+} and Sr^{2+} ions on resins. (HLW)

12724 ION DIFFUSION IN SOILS AND ITS ROLE IN RADIONUCLIDE MIGRATION. Prokhorov, V. M. pp 103-125 of Radioecology. Klechkovskii, V. M. (ed.). New York; John Wiley and Sons, Inc. (1973).

The role of ion diffusion in radionuclide migration in soils is reviewed. The complex nature of migration in soils is emphasized and the effects of biological transport processes, climatic factors, and human economic activities are discussed. Special features of radionuclide diffusion in soil, such as the inhomogeneous properties of soil, are discussed. The migration of nuclides over the soil profile is reviewed with regard to type of soil, climatic zones, isotope composition of nuclides, conditions of their deposition on soil surface, and migration time. The fixation of nuclides, particularly ^{137}Cs, by clay minerals is discussed. Root nutrition of plants is discussed with emphasis on absorption of ^{90}Sr and ^{137}Cs and other radionuclides. (HLW)

Water

12725 (HW-42700) EARTH SCIENCES' WASTE DISPOSAL MONITORING ACTIVITIES SUMMARY, NOVEMBER 1955. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 1955. Contract W-31-109-eng-52. 12p. Dep. NTIS $3.00.

Data are presented on the radioactivity (α, β, and γ) in samples of water from test wells at Hanford collected during November, 1955. The samples were also analyzed for nonradioactive Na and NO_3. (CH)

12726 (ORP/EERF-73-2) CONSTRUCTION AND OPERATION OF AN ION EXCHANGE CARTRIDGE FOR MONITORING RADIONUCLIDES IN THE ENVIRONMENT. Hasuike, J. K.; Windham, S. T. (Eastern Environmental Radiation Facility, Montgomery, Ala. (USA)). Jun 1973. 16p.

The increased emphasis on measuring environmental levels of radioactivity requires a maximum of sensitivity in the collection and analysis of samples. An ion exchange sampler developed by this Facility that has proved very useful in monitoring for low-level radioactive effluents in the environment is described. The sampler consists of a compartmentalized ion exchange column containing a particulate prefilter and cation and anion resins. After use the prefilter and resin are gamma analyzed directly and/or processed via chemical analysis. The column is easy to construct and use, is inexpensive, and is reusable. (auth)

12727 RADIOECOLOGY OF MARINE PLANTS AND ANIMALS. Polikarpov, G. G. pp 311-322 of Radioecology. Klechkovskii, V. M. (ed.). New York; John Wiley and Sons, Inc. (1973).

Radioecology studies on marine organisms are reviewed. Topics discussed are: accumulation of ^{91}Y from seawater by algae

and mollusc shells; role of organic substances in transformation of radionuclide compounds in seawater; distribution of coefficients of accumulation of ^{90}Sr in algae; paths of entry of radionuclides into marine organisms; cytogenetic effects of $^{90}Sr-^{90}Y$ on embryos of red fish; radioecology of communities; and accumulation of radionuclides by algae in the Sargasso Sea. (HLW)

12728 RADIOECOLOGY OF FRESHWATER PLANTS AND ANIMALS. Kulikov, N. V. pp 323-337 of Radioecology. Klechkovskii, V. M. (ed.). New York; John Wiley and Sons, Inc. (1973).

Radioecology studies on freshwater organisms are reviewed. The accumulation of artificial and natural radionuclides by aquatic plants and animals is discussed and tables are presented to show coefficients of accumulation of ^{238}U, ^{226}Ra, and ^{232}Th in various species of plants. Effects of physicochemical factors of the environment, such as content of chemical analogs in the water, hydrogen ion concentration, temperature, and light, on radionuclide accumulation are reviewed. Other topics reviewed are distribution of radionuclides among the components of a water body and effects of radionuclides on aquatic organisms. (HLW)

12729 ACCUMULATION OF ARTIFICIAL RADIONUCLIDES IN FRESHWATER FISH. Fleishman, D. G. pp 347-370 of Radioecology. Klechkovskii, V. M. (ed.). New York; John Wiley and Sons, Inc. (1973).

Accumulation of radionuclides in freshwater fish is reviewed with emphasis on ^{137}Cs and ^{90}Sr in fish of freshwater lakes. Studies on the relation between the level of accumulation of ^{137}Cs in fish and the limnological characteristics of lakes in Finland showed that fish from oligotrophic lakes contained much more ^{137}Cs than those from entrophic lakes because of the low content of potassium in oligotrophic lakes. Studies on coefficients of accumulation of cesium and potassium, and of ^{90}Sr and calcium, in fish are reviewed. A review of investigations on paths of entry of radionuclides into fish included studies on penetration through the gills and outer surface and ingestion of radionuclides with food and water. (HLW)

Ecosystems and Food Cycles

Refer also to abstracts 15119, and 15121–15123.

12730 (CONF-720510-) CARBON AND THE BIOSPHERE. Proceedings of the 24th Brookhaven Symposium in Biology, Upton, New York, May 16–18, 1972. Woodwell, G. M.; Pecan, E. V. (eds.). (Brookhaven National Lab., Upton, N. Y. (USA)). Aug 1973. 399p. Dep. NTIS $10.60.

Separate abstracts were prepared for five of the 19 papers included. The additional papers discuss changes in the carbon budget in ecosystems. (CH)

For abstracts of individual papers see: 12731, and 12754–12757.

12731 (CONF-720510-, pp 8-20) ^{14}C CYCLE AND ITS IMPLICATIONS FOR MIXING RATES IN THE OCEAN–ATMOSPHERE SYSTEM. Stuiver, M. (Univ. of Washington, Seattle). Aug 1973.

From carbon and the biosphere conference; Upton, New York, USA (16 May 1972).

In carbon and the biosphere.

Residence times and exchange rates for carbon in major carbon reservoirs are derived from box-model studies of ^{14}C activity ratios. A diffusion–advection model gives information on oceanic mixing processes and the oceanic transport of carbon of biological origin. Literature associated with this type of global study of carbon transfer and storage is summarized. (auth)

12732 ^{90}Sr INTAKE WITH FOOD PRODUCTS BY THE POPULATION OF THE GEORGIAN SSR AS A RESULT OF GLOBAL FALLOUT FROM 1963 TO 1970. Khazaradze, R. E.; Gorgoshidze, V. A.; Orbeladze, I. A.; Pakeliani, M. M.; Tevdoradze, Ch. M. (Scientific Research Inst. of Sanitation and Hygiene, Tbilisi, USSR). Gig. Sanit.; No. 11, 52-55(Nov 1973). (In Russian).

The results obtained show that the highest concentration of ^{90}Sr was noted in 1963 and 1964. From 1965 to 1967 the content in the majority of food products was diminished 1½, 2-fold and more. These concentrations continued to decrease in following years. The isotope content of local products is greater than its average concentration in the USSR. (auth)

12733 ENVIRONMENTAL RADIOACTIVE POLLUTION AND MAN. Marei, A. N. pp 141-156 of Radioecology. Klechkovskii, V. M. (ed.). New York; John Wiley and Sons, Inc. (1973).

Migration of radionuclides, chiefly ^{90}Sr and ^{137}Cs, from the environment into the human body is reviewed in the light of tasks faced by radiation hygiene. Some topics discussed are: radionuclide migration along food chains from the external environment into the human ration; migration of ^{137}Cs and ^{90}Sr from different types of soil into grass and milk; human intake of radioactive substances in relation to the nature and intensity of environmental contamination; and human metabolism of ^{90}Sr and ^{137}Cs. (HLW)

12734 EFFECT OF IONIZING RADIATION ON FOREST BIOGEOCENOSES. Tikhomirov, F. A.; Aleksakhin, R. M. pp 197-224 of Radioecology. Klechkovskii, V. M. (ed.). New York; John Wiley and Sons, Inc. (1973).

Effects of ionizing radiation on forest plants and animals are reviewed. Studies on the radiosensitivity of arboreal plants showed that coniferous species were the most sensitive. A table is presented to show the dose of gamma radiation reducing the germinative capacity of seeds of arboreal plants by 50%. Studies on the relationship between radiosensitivity of arboreal plants and size of chromosomes, number of chromosomes, and nuclear volume are reviewed. Studies on the reaction of arboreal plants to irradiation are reviewed with regard to stimulating effects of radiation, inhibitory effects on growth, and morphological alterations. Other topics reviewed are: effects of radiation on the reproductive capactiy of arboreal plants, comparative radiosensitivity of insects, birds, and mammals; radiation damage to forests; influence of the structure of forest cenosis and environmental factors on the effect of radiation; disturbances caused by alteration of biocenotic relationships in an irradiated forest cenosis; radiation damage to forests due to radioactive contamination; and tasks in the field of forest radioecology. (HLW)

12735 RADIOECOLOGY OF WILD ANIMALS. Il'enko, A. I. pp 241-274 of Radioecology. Kelchkovskii, V. M. (ed.). New York; John Wiley and Sons, Inc. (1973).

The accumulation of radionuclides by animals, the migration of radioactive substances along food chains, and the distribution of doses in the different zoocenosis components are being studied. A study of the accumulation of ^{137}Cs, ^{65}Zn, ^{90}Sr, ^{60}Co, and ^{106}Ru by rodents on sites of local burial of radioactive waste showed that small animals accumulated considerably larger amounts of radionuclides than larger rodents. Discussions are presented of seasonal variations in the accumulation of radionuclides in animal populations, effects of age and sex on the buildup of radionuclides in animal populations, transport of radionuclides by migratory animals, biological effect of territorial radioactive contamination on animal populations, mortality and life-span in animal populations on a territory with high content of radioactive substances, variation in the fecundity of populations exposed to ionizing radiation, effect of ionizing radiation on development, effect of incorporated radionuclides on immunity, blood status, and appearance of pathological conditions, effect of ionizing radiation on animal behavior, radioresistance of animals, variability in populations of animals inhabiting a territory contaminated by radioactive fission products, and current tasks of animal radioecology. (HLW)

12736 RADIOECOLOGY OF FARM ANIMALS. Korneev, N. A.; Burov, N. I.; Sirotkin, A. N.; Nikolaeva, E. M.; Antakova, N. N.; Suslova, V. V. pp 275-282 of Radioecology. Klechkovskii, V. M. (ed.). New York; John Wiley and Sons, Inc. (1973).

The effects of various environmental factors on the influx of ^{90}Sr from soils into plants and its migration from plants into cattle, sheep, and goats were studied. The distribution of ^{90}Sr over the soil profile differed according to tillage and the largest intake of ^{90}Sr into plants occurred from the surface layer. The uptake of ^{90}Sr in the skeleton of ruminants was related to the species and age; the uptake was greatest in bone tissue and muscles of young animals and was higher in the skeleton of sheep than of goats. An experiment is described in which the migration of ^{90}Sr from fodder into cows' milk was examined. The largest ingestion of ^{90}Sr occurred when the cows were pastured out. Results indicated that the intensity of ^{90}Sr migration in different links of trophic chains was controlled by the type of plants, the specific properties of the dominant species, and the modes of their utilization by farm animals. (HLW)

12737 RADIOECOLOGY OF LANDSCAPES IN THE FAR NORTH. Troitskaya, M. N.; Ramzaev, P. V.; Moiseev, A. A.; Nizhnikov, A. I.; Bel'tsev, D. I.; Ibatullin, M. A.; Litver, B. Ya.; Dmitriev, I. M. pp 283-308 of Radioecology. Klechkovskii, V. M. (ed.). New York; John Wiley and Sons, Inc. (1973).

Radioecology studies in the Far North are reviewed. The significance of the air is discussed as a source of direct influx of radioactive substances into animals and man and a table is presented to show total long-lived beta activity of aerosols and ^{90}Sr concentration in air of various regions. The gamma background of arctic regions is discussed and data are tabulated for various regions. The importance of soil in estimating contamination of links in ecological chains is discussed and data on ^{90}Sr and ^{137}Cs content of the soil-plant cover are tabulated.

A discussion of the radioecology of vegetation includes data on ^{137}Cs and ^{90}Sr content of lichens, migration of ^{137}Cs and ^{90}Sr from soil into lichens and ecological parameters of lichens with respect to ^{210}Pb and ^{210}Po. Studies on the radioecology of reindeer are discussed with regard to the significance of ^{137}Cs, ^{90}Sr, ^{210}Pb, and ^{210}Po content of the meat, a main source of human food. Studies on human populations were concerned with concentration of ^{137}Cs in reindeer herders, inhabitants of rural settlements, and inhabitants of cities. (HLW)

Radiometric Techniques

Refer also to abstracts 12707, 12770, 12804, 12805, 12807, and 15074.

12738 DEPTH INTERVALS AND TOPSOIL MOISTURE MEASUREMENT WITH THE NEUTRON DEPTH PROBE. Kristensen, K. J. (Konfwlifw Cwrweinwe- og Landbohoejskole, Copenhagen). Nord. Hydrol.; 4: No. 2, 77-85(1973).

From measurements and calculations using a depth probe, the relative response is estimated for soil layers of different thicknesses. For a 10 cm thick layer of soil with the instrument centre in the middle, about 40 to 70% of the response is caused by this particular layer at a water content of 8 to 40% by volume. For a 20 cm layer the response for similar conditions is about 65 to 85%. A special calibration function for the upper (0-20 cm) soil layer is demonstrated for the neutron depth probe. It is found that the water content in this soil layer can be estimated in this way with about the same degree of accuracy as can be expected by conventional methods. (auth)

12739 DETERMINATION OF SOME CONSTANTS OF THE TRACER DYNAMICS IN FIELD INVESTIGATIONS. Oncescu, M.; Gaspar, E.; Dinescu, L. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 18: No. 8, 1023-1033(1973).

Radioactive tracer migration in soils is governed by hydrodynamic dispersion and physicochemical dispersion. Methods used for the determination of some constants characterizing the dispersion phenomena (such as the longitudinal dispersion coefficient and distribution coefficient) and the data obtained are presented. (auth)

12740 BASIC ASSUMPTIONS IN K-Ar DATING METHOD. Hayatsu, A. Comments Earth Sci., Geophys.; 3: No. 3, 69-75 (1972).

The problem of initial argon in K-Ar dating method is considered and the following rules of thumb are recommended when K-Ar ages are used: the ages based only on one type of mineral should be treated with caution, no matter how good the internal agreement is; if the ages determined on greatly different minerals agree with each other, the effect of initial argon can be considered to be negligible; and future K-Ar dating should be made with due considerations for the effect of initial argon. (DHM)

12741 TASKS OF DOSIMETRY IN RADIOECOLOGY. Tikhomirov, F. A. pp 225-240 of Radioecology. Klechkovskii, V. M. (ed.). New York; John Wiley and Sons, Inc. (1973).

A review of dosimetric methods in radioecology is presented. Radiation sources are discussed with regard to point sources, such as ^{60}Co and ^{137}Cs, and distributed sources. The use of point sources is discussed from the standpoint of dosimetry in an ambient biotic environment. The use of distributed sources is discussed with regard to studies on radioactive fallout and behavior of radionuclides within a community. A review of dosimetric assessment methods includes discussions of calculation methods, external dose due to radioactive fallout, internal dose, and experimental methods. Possible experimental approaches to the tasks of dosimetry in radioecological problems are summarized. (HLW)

Site Surveys

Refer also to abstracts 13282, 14750, and 15113.

12742 (BNWL-CC-2174) ANALYSIS OF CRUSTAL CHANGES IN THE COLUMBIA PLATEAU AREA FROM CONTEMPORARY TRIANGULATION AND LEVELING MEASUREMENTS. Tillson, D. D. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 12 Feb 1970. 59p. Dep. NTIS $5.00.

An analysis of geodetic data in the Columbia Plateau area of southeastern Washington and northeastern Oregon was made to obtain historical changes in the first order benchmark and triangulation network in the area, and to relate such changes to regional geologic structure, as part of a continuing effort to establish the seismicity for the Hanford area. Using this information, nuclear processes and facilities can be analyzed for response to predicted seismic disturbance, and any needed steps taken to modify the system to satisfy required safety standards. (auth)

12743 (CONF-730581-1) BIOLOGICAL EFFECTS OF UNDERGROUND NUCLEAR TESTING ON MARINE ORGANISMS. II. Observed Effects of Amchitka Island, Alaska, Tests on Marine Fauna. Isakson, J. S. (Washington Univ., Seattle (USA). Fisheries Research Inst.). 1973. 13p. Dep. NTIS $3.00.

From conference on the environmental effects of explosives and explosions; White Oak, Maryland, USA (30 May 1973).

The biological effects of the Longshot, Milrow, and Cannikin underground nuclear tests at Amchitka Island, Alaska, on marine mammals, fishes, and birds are summarized. The biological effects observed were related to the water-borne shock waves produced by the explosions. (CH)

12744 (CONF-730581-2) BIOLOGICAL EFFECTS OF UNDERGROUND NUCLEAR TESTING ON MARINE ORGANISMS. I. Review of Documented Shock Effects, Discussion of Mechanisms of Damage, and Predictions of Amchitka Test Effects. Simenstad, C. A. (Washington Univ., Seattle (USA). Fisheries Research Inst.). 1973. 26p. Dep. NTIS $3.50.

From conference on the environmental effects of explosives and explosions; White Oak, Maryland, USA (30 May 1973).

The potential mechanisms of biological damage to fish resulting from a nuclear-induced shock wave appear to involve mechanical damage from bottom acceleration and rockspall; the synergistic effect of compression to decompression producing the mechanical expansion of gas spaces within the organism; effects of cavitation; and possibly the alteration of blood constituents. The indirect effects of the shock wave should also be considered in a truly ecological approach. Loss of fish or other marine organisms may reduce food resources for other species and place an unusual stress upon the community's food web and increased predation created by the influx of a formerly minor constituent may also be a real consideration. The determinants of biological damage involve the anatomical morphology, the ecological characteristics of the various members of the fish community, and the physical characteristics of the environment as produced by the introduced shock wave. (auth)

12745 (COO-2307-4) CHECK LIST OF VASCULAR PLANTS OF THE NEVADA TEST SITE AND CENTRAL-SOUTHERN NEVADA. Beatley, J. C. (Cincinnati Univ., Ohio (USA). Dept. of Biological Sciences). Dec 1973. Contract AT(11-1)-2307. 43p. Dep. NTIS $4.25.

A list is presented of 706 vascular plant taxa collected at the Nevada Test Site from 1959 through 1972. A list of 1,107 taxa found in central and southern Nevada is included. (CH)

12746 (HDC-2564) RDA-DC-6 TEST BORINGS AT COYOTE RAPIDS SITE. Shadel, F. H. (Hanford Works, Richland, Wash. (USA)). 22 Apr 1952. 44p. Dep. NTIS $4.25.

Declassified 7 Mar 1958.

Data on the geology of the Coyote Rapids Site at Hanford are summarized on the basis of observations made on soil samples from nine 40-ft deep test holes drilled in the area during 1952. (CH)

12747 (HW-40469) CHANGES IN THE HANFORD GROUND WATER TABLE, 1944-1955. McConiga, M. W. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 1955. Contract W-31-109-eng-52. 12p. Dep. NTIS $3.00.

Contour maps drawn from water level data of more than 100 water wells in and about the Hanford Works Separations Areas define the height and spread of the ground water mounds built up by the disposal of waste water from the several plants. Close control on the 200-West mound is provided by 25 wells within the area and others closely encircling it. Twelve wells define the ground water mound which lies east of the 200-East Area. The ground water table beneath the 200-West Area rose about 95 feet and spread in a 3 by 5-mile pattern as three plants and a total of 19 billion gallons of water were added during the 11 year period from 1944 through 1955. The 200-East mound rose about 15 feet with seven years of operation and 6.5 billion gallons of waste water, then began to fall with the cessation of the B Plant operation, causing an increased west-to-east gradient in the ground water. (auth)

12748 (HW-50239) HAPO SOIL INFORMATION. Udine, G. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 4 Oct 1956. 42p. Dep. NTIS $4.25.

Extensive soil investigations were made at Hanford for underground waste disposal systems and for all foundations of important structures from preHanford Works day to 1956. This soil information was filed in a number of different places and some of the data was combined with other subject matter. A guide and

index showing the location of existing soil data pertaining to HAPO is presented, including copies of test hole logs, soil bearing data, and miscellaneous soil information. The geologic features of the Hanford area are described. (CH)

12749 (HW-61796) TEST OF THE REFRACTION SEISMIC METHOD ON THE HANFORD PROJECT. Raymond, J. R.; Ratcliffe, C. A. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 25 Sep 1959. Contract AT(45-1)-1350. 22p. Dep. NTIS $3.25.

The practicability of magnetic geophysical and seismic methods for investigating geologic and hydrologic features of the Hanford Reservation affecting ground disposal of liquid radioactive wastes was investigated. The theory of the refraction seismic method of geophysical investigation is briefly discussed. The method was tested on the Hanford project by use of a laboratory-built single channel seismograph. The instrument generally operated adequately and the tests were successful. The method was tried at two sites; one selected to attempt detection of the ground-water aquifer surface and the other to attempt detection of the basalt bedrock surface. At both sites the responding horizon was less than 50 feet below the surface. In both cases the surface of the responding horizon was delineated within an accuracy of a few feet. It is concluded that seismic surveys with well-developed commercial instruments will provide valuable knowledge of depth to basalt and other geologic horizons. (CH)

12750 (HW-67415) EVALUATION OF EARTH SAMPLES FROM CHURN-DRILLED WELLS. Brown, D. J. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 19 Nov 1960. Contract AT(45-1)-1350. 14p. Dep. NTIS $3.00.

The reliability of bailed samples of earth material from a churn-drilled well for quantitatively evaluating the chemical and physical properties of the natural geologic formations underlying the Hanford region was evaluated. For this purpose samples from two Hanford locations were obtained. At each location two adjacent wells were sampled, one by bailing and the other by a core-barrel technique. The size distribution, calcium carbonate content, pH, and cation exchange capacity of the samples were used as criteria for comparison. Some of these characteristics showed large differences between samples from the different wells. However, a statistical analysis of the data indicates insufficient bias to justify the conclusion that the sampling method contributes significantly to these differences. This analysis gave no basis for suspecting the reliability of churn-drilled and bailed samples for representing the soil characteristics included in this test. (auth)

12751 (NOAA-TM-ERL-ARL-39) ATMOSPHERIC TRANSPORT AND DIFFUSION IN THE PLANETARY BOUNDARY LAYER, JULY 1971–JUNE 1972. Van der Hoven, I. (ed.). (National Oceanic and Atmospheric Administration, Silver Spring, Md. (USA). Air Resources Labs.). Jun 1973. 84p.

A computerized model has been programmed to calculate the effects of simulated reactor accident and annual average atmospheric dilution factors on contamination of the environment by nuclear power stations. This program makes it possible to rapidly evaluate potential nuclear power station sites in a consistent manner. For input to the program, the applicant must provide a joint frequency distribution of wind speed and stability classes for each directional sector from a representative 12-month period. In most cases, periods of calm are included separately as the number of calms occurring for each stability class. The program assigns the calms to the various sectors in the same ratio as the lowest wind speed class and adds them to that category. Also included as input to the program are the distances to the site boundary for each sector, the cross-sectional area and height of the reactor building, and the distance to the nearest population center. If the reactor has a stack, the applicant also includes the height and diameter of the stack and the exit velocity of effluent, the distance and bearing of the stack from the reactor, the distances from the stack to the site boundaries for each sector, and information on terrain. Terrain heights and distances are read into the program for each sector and the program performs a linear interpolation to obtain the terrain height at any needed location. Plume rise is determined by the formulas developed by Briggs (1969). Methods used for the measurement of the meteorological parameters required are described. Results are included from a study on the effect of a city on the low-level windfield, carried out at Oklahoma City and in Colorado. Data are also included from studies on the effects of sampling interval on turbulent energy spectra, directional wind shear under low wind speed conditions, the applicability of geostrophic winds to mesoscale transport, the use of mesoscale windfield data in the preparation of prognostic weather charts, diagnostic applications of wind speed and component spectra, and methods for the prediction of long-term trajectories of radioactive gaseous effluents using single and multi-station models and long distance transport and diffusion of gaseous wastes. (CH)

12752 (RLO-2227-T-12-41) NONCONSERVATION OF HEAVY METALS IN THE COLUMBIA RIVER ESTUARY. Cutshall, N.; Holton, R.; Small, L. C. (Oregon State Univ., Corvallis (USA). School of Oceanography). 1973. Contract AT(45-1)-2227. 15p. Dep. NTIS $3.00.

Manganese, copper, and zinc in filtered waters are not conserved during mixing of Columbia River water with seawater. Metal concentrations at about seven percent salinity are higher than would result from conservative mixing. It is concluded that the excess metals are derived from riverborne suspended matter. Reprecipitation of the metals seems to occur at about twenty percent salinity. (auth)

12753 (RT/PROT-(73)19) EVALUATION OF THE VERTICAL DISPERSION OF GASEOUS EFFLUENTS IN A SHORT INTERVAL AT THE BRASIMONE SITE. Advancement Report No. 1. Cagnetti, P. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 6 Jul 1973. 30p. (In Italian). Dep. NTIS (U.S. Sales Only) $3.50.

Results are reported that were obtained from a set of experiments carried out at the Brasimone reactor site to evaluate the dilution of gaseous radioactive effluents in the range of 0.5 to 1 km, by means of the analysis of the behavior of smoke releases. The preliminary results were used to describe the orographic and climatologic effect on the atmospheric diffusion in the boundary layer over the site, and secondly to plan future experiments to investigate more accurately some situations particularly unfavorable from the point of view of the atmospheric dilution of gaseous releases over short distances, as when the calm of wind is present during a period characterized by strong vertical stability. (auth)

Thermal Effluents

Refer also to abstracts 14748 and 15012.

Chemical Effluents

Refer also to abstracts 12730 and 12752.

12754 (CONF-720510-, pp 51-85) ATMOSPHERIC CARBON DIOXIDE AND RADIOCARBON IN THE NATURAL CARBON CYCLE. I. Quantitative Deductions From Records at Mauna Loa Observatory and at the South Pole. Ekdahl, C. A.; Keeling, C. D. (Univ. of California, San Diego, La Jolla). Aug 1973.

From carbon and the biosphere conference; Upton, New York, USA (16 May 1972).

In carbon and the biosphere.

The concentration of atmospheric CO_2 in the Northern Hemisphere increased by 6.8 ppM from 1959 to 1969, according to a long series of measurements at the Mauna Loa Observatory, Hawaii. In the same period the Southern Hemisphere concentration increased by 6.7 ppM, according to an even longer series of measurements of South Polar air. These increases, when averaged, correspond to 2.34% of the presumed preindustrial CO_2 concentration of 290 ppM and imply that approximately 49% of the contemporary production of CO_2 from combustion of fossil fuel and kilning of limestone remained airborne. The approximately 51% not remaining airborne was evidently incorporated into the oceans and land biota. To learn more about this uptake, we have taken into account atmospheric radiocarbon (^{14}C) variations as recorded in tree rings, and to interpret this record we have examined a series of geochemical models of the reservoirs into which CO_2 and ^{14}C can mix. The essential character of these models was established by evaluating an analytically derived atmospheric transfer function for a wide range of linear-model parameters. For a purely oscillatory ^{14}C source, this function gives the attenuation and phase shift of $^{14}CO_2$ in the lower atmosphere; for a purely exponentially increasing CO_2 source, it gives the fraction of CO_2 remaining airborne or in the lower atmosphere. In both cases the source is assumed to have operated until initial transient variations have died out. For reasonable reservoir sizes and transfer times, the stratospheric (heliomagnetic) variation in $^{14}CO_2$, as estimated from direct observations of cosmic rays and sunspot numbers, is strongly attenuated in the lower atmosphere, whereas the predicted airborne fraction agrees with the earlier implied value of 49% (42% for the lower atmosphere) only if the carbon pool of the land biota grows appreciably. These models, with nonlinear corrections, are used to predict year-by-year simultaneous variations in atmospheric CO_2 and $^{14}CO_2$. (auth)

12755 (CONF-720510-, pp 86-135) ATMOSPHERIC CARBON DIOXIDE AND RADIOCARBON IN THE NATURAL CARBON CYCLE. II. Changes From A. D. 1700 to 2070 as Deduced From a Geochemical Model. Bacastow, R.; Keeling, C. D. (Univ. of California, San Diego, La Jolla). Aug 1973.

From carbon and the biosphere conference; Upton, New York, USA (16 May 1972).

In carbon and the biosphere.

A nonlinear geochemical model of the interaction of atmospheric CO_2 with the oceans and land biota has been constructed to predict future changes in atmospheric CO_2 concentration in the next century. If production of CO_2 from fossil fuels continues, the perturbations from preindustrial times may become so large that a linear model is unrealistic, especially because it fails to take into account that ocean surface water will become progressively more acid and less able to absorb each new increment of industrial CO_2. On the assumption that industrial CO_2 production continues to increase at the rate of the past 20 years and that the ultimate increase in biomass of the land biota is no more than twice the present biomass, the atmospheric CO_2 concentration will reach a value six to eight times the preindustrial value in 100 years. When the ^{14}C concentration in dated wood and the recent atmospheric increase in CO_2 are compared in the context of the model, it appears that the land biomass has increased 1 to 3% since the beginning of the industrial era. This calculation takes account of the actual year to year variations in industrial CO_2 production and the heliomagnetic variation in ^{14}C production in the stratosphere. The inferred biomass increase, presumably owing to CO_2 fertilization, is too small to be verified by direct observation and is not considered to be established. On the other hand, the trend in atmospheric CO_2 apparently rules out any large recent change in biomass. (auth)

12756 (CONF-720510-, pp 136-143) ATMOSPHERIC CARBON MONOXIDE. Cadle, R. D. (National Center for Atmospheric Research, Boulder, CO). Aug 1973.

From carbon and the biosphere conference; Upton, New York, USA (16 May 1972).

In carbon and the biosphere.

Carbon monoxide (CO) is a colorless, odorless gas produced principally by combustion of organic substances. It is probably also produced by bacterial action on land and in the oceans. Concentrations in the natural troposphere average 0.1 to 0.2 ppMV (parts per million by volume). In smoggy city air 40 ppMV is common. The mechanisms of removal of CO from the atmosphere are not well known but seem to include chemical reactions in both the troposphere and stratosphere and bacterial action at Earth's surface. (auth)

12757 (CONF-720510-, pp 159-181) ATMOSPHERIC SULFUR AND ITS LINKS TO THE BIOTA. Hill, F. B. (Brookhaven National Lab., Upton, NY). Aug 1973.

From carbon and the biosphere conference; Upton, New York, USA (16 May 1972).

In carbon and the biosphere.

The atmospheric sulfur cycle is reviewed with emphasis on its connections to the biota. Topics discussed concerning these connections are: biometeorological factors affecting rates of uptake of sulfur dioxide by vegetation; the use of regional atmospheric pollution models to predict acidity in precipitation; and factors affecting emission of biogenic sulfur compounds into the atmosphere; and the effects of fossil fuel combustion on the production of SO_2 and its release to the atmosphere. (CH)

INSTRUMENTATION

Radiation Detection Instruments

Refer also to abstracts 13255 and 13261.

General Detectors and Monitors

Refer also to abstracts 13030, 13257, 13289, 14265, 14627, 14664, 14671, and 14823.

12758 (ANL-8060(Pt. 2), pp 277) INSTANT WORKING LEVEL METER WITH AUTOMATIC INDIVIDUAL RADON DAUGHTER READOUT FOR URANIUM MINES. Groer, P. G.; Keefe, D. J.; McDowell, W. P.; Selman, R. F. 1973.

Radiological and Environmental Research Division annual report, July 1972 – June 1973.

The Instant Working Level Meter (IWLM) evaluates the working level (WL) and the individual radon-daughter concentrations in a uranium mine atmosphere within five minutes. The instrument is portable and fully automatic. The WL and the Ra A, Ra B, and Ra C concentrations (pCi/liter) are displayed in digital form. Calculation of these quantities is performed by a preprogrammed CMOS calculator chip, using the counts observed in the instrument's three channels (Ra A, Ra B + C, Ra C'). The radon daughters are collected on a membrane filter at a flow rate of 12 l/min. Alpha-spectroscopy is performed with a silicon surface barrier detector, the $\beta + \gamma$ counts are detected with a plastic scintillator plus photomultiplier tube. No assumptions about radon-daughter equilibrium are made. Only constancy of the radon-daughter concentrations during the time of sampling (2 min) is assumed. The unit is entirely solid state with exception of the photomultiplier. The range of the instrument is 0.01 to 100 WL. (auth)

12759 (BARC-690, pp 146-152) FISSION AND RELATED STUDIES USING SOLID STATE TRACK DETECTORS. 1973.

The fission track registration efficiency of Lexan track detectors immersed in solutions of fissile materials is reported. Also, results of neutron flux mapping at the Apsara reactor using dielectric track detectors are presented and discussed. (WHK)

12760 (BARC-690, pp 153-154) EFFICIENCY CURVES FOR Ge(Li) DETECTORS. Dange, S. P.; Ramaswami, A.; Manohar, S. B.; Prakash, S. 1973.

In connection with the work on the estimation of fissile isotopes using gamma spectroscopy, the efficiency curves for gamma energies up to 400 keV were constructed using samples in the form of solutions employing a 2 cc Ge(Li) detector having a resolution of 3.6 keV at 122 keV. The energy range was covered using the nuclides ^{241}Am, ^{144}Ce, ^{235}U, ^{241}Pu, ^{131}I, and ^{153}Sm. (WHK)

12761 (FRNC-TH-410) DEVELOPMENT OF A PARTICLE DETECTION SIMULATION SYSTEM USING ELECTROLUMINESCENT DIODES CONTROLLED BY THE INTERMEDIATE OF A CAMAC DEVICE. Maltese, P. (Strasbourg-1 Univ., 67 (France)). 1973. 102p. (In French). Dep. NTIS (U. S. Sales Only) $7.25.

Thesis.

A simulation system for the detection of particles, which uses electroluminescent diodes is described. In this way, the regulation of the various electronic selection devices associated with the scintillation detectors and the control of the detector system performance (both on line and off-line) can be effected for high energy physics experiments. The CAMAC system, designed for on-line use with various computers, possesses an interconnection system for the transfer of data or orders. A specific program enables the apparatus to be used for the automatic verification of the operation of the entire detection system together with the simulation of all of the characteristics of the signals, thus permitting the complete reconstitution of the various stages of an experiment. Tests carried out on the electronic selection system involve signals of defined amplitudes arriving at fixed time intervals. In order that the real time and overall control of the detection system be made as good as possible, it is necessary to inject the light traversing the optical coupling from the scintillators into the photocathode. It is for this reason that electroluminescent diodes were implanted in the scintillators. In this way any deterioration in the transmission of light from the scintillator to the photomultiplier or of the scintillator can be detected. (FR)

12762 (FRNC-TH-413) RESEARCH AND DEVELOPMENT OF A PROPORTIONAL COUNTER FOR LOCALIZING AND IDENTIFYING CHARGED PARTICLES IN THE FOCAL PLANE OF A MAGNETIC SPECTROMETER. Saghai, B. (Paris-11 Univ., 91 - Orsay (France)). 1973. 103p. (In French). Dep. NTIS (U. S. Sales Only) $7.25.

Thesis.

A monowire proportional counter was developed for localizing and identifying charged particles in the focal plane of a heavy ion magnetic spectrometer intended for the Orsay tandem Van de Graaf. This counter can also be used for light ions with the split-pole spectrometer. The cavity of the square cross section counter corresponding to a length of 400 mm and a width of 14 mm has the following dimensions 450 × 22 × 22 mm. The localization is effected using a potential divider principle. The various factors determining the characteristics of the counter (nature and pressure of the gas; diameter of the wire; operating potential) are examined. The experimental value of the gas multiplication coefficient (propane) is discussed. The fluctuations in energy losses and the multiple scattering limiting the energy and spatial resolution are calculated. The following results were obtained in measurements of the performance: an energy and spatial resolution of 5% and 1.0 mm respectively (at 800 V) for oxygen at 47 MeV; an energy and spatial resolution of 5% and 0.9 mm respectively (at 800 V) for oxygen at 52.4 MeV with an angle of incidence of 45 deg. These two characteristic parameters were also measured using ^{212}Pb sources. The energy losses corresponding to 6.78 and 6.1 MeV α particles were 0.80 and 1.10 MeV respectively. The energy resolution at 1100 V was 10%. (FR)

12763 (N-73-30424) SHAPED SCINTILLATION DETECTOR SYSTEMS FOR MEASUREMENTS OF GAMMA-RAY FLUX ANISOTROPY. Trombka, J. I.; Vette, J. I.; Stecker, F. W.; Eller, E. L.; Wildes, W. T. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Aug 1973. 31p. (NASA-TM-X-70445; X-641-73-230). NTIS $3.75.

The detection efficiencies of cylindrical detectors for various gamma ray photon angular distributions were studied in the energy range from .10 MeV to 15 MeV. These studies indicate that simple detector systems on small satellites can be used to measure flux anisotropy of cosmic gamma rays and the angular distribution of albedo gamma rays produced in planetary atmospheres. The results indicate that flat cylindrical detectors are most suitable for measuring flux anisotropy because of their angular response function. A general method for calculating detection efficiencies for such detectors is presented. (auth)

12764 (N-73-31415) PARTICLE TRACK DETECTORS. Interim Report No. 27. Benton, E. V.; Gruhn, T. A.; Andrus, C. H. (San Francisco Univ., Calif. (USA). Dept. of Physics). Jun 1973. 35p. (NASA-CR-124381). NTIS $3.75.

Aqueous sodium hydroxide is widely used to develop charged particle tracks in polycarbonate film, particularly Lexan. The chemical nature of the etching process for this system has been determined. A method employing ultraviolet absorbance was developed for monitoring the concentration of the etch products in solution. Using this method it was possible to study the formation of the etching solution saturated in etch products. It was found that the system super-saturates to a significant extent before precipitation occurs. It was also learned that the system approaches its equilibrium state rather slowly. It is felt that both these phenomena may be due to the presence of surfactant in the solution. In light of these findings, suggestions are given regarding the preparation and maintenance of the saturated etch solution. Two additional research projects, involving automated techniques for particle track analysis and particle identification using AgCl crystals, are briefly summarized. (auth)

12765 EFFECT OF CHANNEL WIDTH IN DETERMINING CENTROID SHIFTS. Hutcheon, D. A. (Univ. of Alberta, Edmonton). Nucl. Instrum. Methods; 113: No. 2, 221-223(1973).

It is shown that channel width of a multichannel analyzer distribution in general should cause negligible error when centroid shifts of less than a channel are observed in measurements of nuclear lifetimes by direct timing. Published data on lifetimes in ^{111}In and ^{113}In are re-analyzed in the light of this conclusion. (auth)

12766 HUMIDITY EFFECTS IN IONIZATION CHAMBERS. Bengtsson, L. G. (National Inst. of Radiation Protection, Stockholm). Nucl. Instrum. Methods; 113: No. 2, 309(1973).

Capacitance variations due to humidity alterations have been suggested as the cause of ionization chamber current variations. The validity of the arguments is seriously questioned on several points. (auth)

12767 LOW PRESSURE SPARK CHAMBER. Ohashi, Y. (Nagoya Univ., Japan). Nucl. Instrum. Methods; 113: No. 2, 217-220(1973).

Dependence of a spark chamber detection efficiency on a gas

pressure was investigated at pressures lower than 1 atm. Results are explained by considering not all of seed electrons, but an effective part of them is accelerated in a gap length of the spark chamber. Comparison of efficiency curves for Ar and He gases indicates that a low pressure He spark chamber can be made useful as ionization discriminator of incident particles. (auth)

12768 PREPARATION OF WELL-DEFINED DEPOSITS OF $^{235}UO_2$. Adair, H. L. (Oak Ridge National Lab., TN). Nucl. Instrum. Methods; 113: No. 4, 545-548(1973).

Well-defined layers of $^{235}UO_2$ for use in fission chambers can be prepared by the vacuum evaporation technique. Contaminants introduced by the procedures of painting or electroplating are avoided by evaporating the material directly from a $^{235}UO_2$ pellet by electron bombardment heating. The resulting targets are characterized by alpha or gamma counting. (auth)

12769 ANALYZING POWER OF SILICON FROM 4 MeV TO 16 MeV. Martin, J. P. (Univ. of Montreal); Foster, J. L.; Hiddleston, H. R.; Darden, S. E. Nucl. Instrum. Methods; 113: No. 4, 477-482(1973).

The analyzing power for proton scattering on the ground state and the 1.78 MeV level of silicon has been measured at 34 energies in the 4 to 16 MeV range. Angular coverage was from 20° to 170° in 10° increments. This information is of particular interest for the design of high efficiency double scattering polarimeters using a silicon detector as the analyzer. A detailed calculation for a realistic polarimeter geometry has been completed, which yields a uniform analyzing power of 0.4 for 9.5 to 16 MeV protons, with an efficiency of 0.6×10^{-4}. (auth)

12770 IONIZATION CHAMBER FOR ^{222}Rn MEASUREMENTS. Hoegberg, S. A. C.; Gustavsson, J. E. (Uppsala Univ.). Nucl. Instrum. Methods; 113: No. 4, 583-588(1973).

A 4-l ionization chamber for ^{226}Ra determination for corrections in uranium/thorium age estimations is described. By measuring the activity of ^{222}Rn in secular equilibrium with ^{226}Ra, the ^{226}Ra activity of a sample can be determined. The sample is kept in a flask for about one month to achieve secular equilibrium. By flushing nitrogen through the sample liquid, the radon is transferred into the counter. Integral counting is used. The high-voltage characteristics show a slope of less than 0.1% per 100 V. A discriminator shift of 1% causes a 0.2% change in the counting rate. Activities in the order of 0.01 dpm can be detected with this counter. (auth)

12771 FORMATION OF CURRENT PULSES IN SEMICONDUCTOR NUCLEAR RADIATION DETECTORS. Williams, R. N.; Lawson, E. M. (Australian Atomic Energy Commission, Lucas Heights). Nucl. Instrum. Methods; 113: No. 4, 597-598(1973).

Simple experimental evidence from a high-purity germanium detector is presented to show that Ramo's theorem correctly predicts the shape of radiation-induced current pulses in semiconductor detectors. (auth)

12772 AMPLITUDE DEPENDENCE OF THE INDUCTION SIGNAL IN MULTIWIRE PROPORTIONAL COUNTERS. Dagan, J.; Novick, R.; Weisskopf, M. C. (Columbia Univ., New York). Nucl. Instrum. Methods; 113: No. 4, 595-596(1973).

The signal induced onto the cathode wires in an imaging proportional counter was studied as a function of cathode-wire diameter. The induction signal amplitude was found to vary exponentially with cathode-wire diameter. (auth)

12773 TEMPERATURE EFFECTS IN THE RESPONSE OF PILOT MINERAL OIL LIQUID SCINTILLATOR. Bemporad, C.; Calvetti, M.; Costantini, F.; Del Colletto, F.; Lariccia, P. (Univ., Pisa, Italy). pp 605-607 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

The temperature dependence in the response of Pilot mineral oil scintillator (standard efficiency) has been measured. The temperature interval explored was from 0 to 60°C. The experimental method is discussed. (auth)

12774 CIRCUIT TO IMPROVE NaI RESOLUTION UNDER A CONDITION OF NON-CONSTANT BEAM. Piccioni, O.; Mehlhop, W.; Scipione, D.; Allen, P.; Bowles, P.; Sebek, J.; Caldwell, P.; Babcock, B.; Kostoulas, I. pp 608 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

A negative feedback loop circuit with light emitting diodes that compensates for the background fluctuations due to the variable intensity of an accelerator is briefly described. Such fluctuations can add a 10% spread to the resolution of a crystal-photomultiplier assembly. (auth)

12775 EFFICIENCY AND BACKGROUND VARIATIONS OF A PROPORTIONAL COUNTER WITH CARBON DIOXIDE FILLING. Chudy, M.; Povinec, P.; Seliga, M. (Komensky Univ., Bratislava). Fyz. Cas.; 22: No. 3, 179-185(1972).

Sources of detection efficiency variations, namely the concentration of electronegative impurities, variations of the gas filling pressure and temperature, the instability of the discrimination level and the working voltage and the barometric effect were studied. A method for their elimination is presented. (Nucl. Sci. Abstr. Czech.)

12776 FABRICATION AND CHARACTERISTICS OF THIN FILM NEUTRON THERMOPILE FOR REACTOR INSTRUMENTATION. Kim, D. H. J. Korean Inst. Elec. Eng.; 9: No. 5, 1-5(1972).

In order to improve the response time of neutron thermopiles for reactor control a vacuum evaporated thin film thermocouple was fabricated and tested. The test results were compared with wire-type neutron thermopiles. Good linearities between the response of the neutron thermopile and the thermal flux has been shown in the ranges from 2×10^8 to 8×10^{12} n/cm^2/sec. Thermal neutron flux distributions in the core of the TRIGA Mark-II reactor were measured using the fabricated neutron thermopile, and the results were compared with data obtained by activation foil measurement. (Korean Sci. Abstr.)

12777 MODEL FOR CALCULATING PROMPT-RESPONSE OF SELF-POWERED NEUTRON DETECTORS. Jaschik, W.; Seifritz, W. (Technische Univ., Hanover). Nucl. Sci. Eng.; 53: No. 1, 61-78(Jan 1974).

A sophisticated model is presented for the calculation of prompt-response self-powered neutron (SPN) detectors used for stationary as well as nonstationary neutron flux measurements in nuclear reactor cores. The technique recommended for calculating the unit sensitivity in terms of A/(cm) per unit flux takes the following into account: (1) neutron self-shielding factor of the emitter; (2) flux depression correction; (3) Compton and photoelectron production rate due to self-absorption of the gamma-ray cascade emitted immediately after neutron capture; (4) electron escape probability from the emitter; (5) loss of electron energy within the emitter; and, (6) range of the electrons in the insulator which contains a space-charge electric field. Calculated thermal and fast unit sensitivities in a typical light-water-reactor neutron spectrum for four potential prompt-response SPN detectors, whose emitters consist of cobalt, cadmium, erbium, and hafnium, are compared with experimental data and are found to be in satisfactory agreement. (auth)

12778 AUTOMATIC DETERMINATION OF DECAY RATES OF SINGLE- AND DOUBLE-LABELLED SAMPLES WITH THE AID OF A PROGRAMMABLE DESK COMPUTER IN OFF-LINE REGIME. Wegner, J.; Bahn, M.; Hock, B. (Univ., Bochum, Ger.). Kerntechnik; 15: No. 10, 467-472(Oct 1973).

It is shown on the basis of examples related to practical work that, in liquid scintillation counting, quench corrections for single- and double-labelled samples can easily be carried out with the aid of a programmable desk computer (Diehl Algotronic). The number of measured points used in practice for establishing calibration curves, approximated by third degree parabolas fitted by the method of least squares, is not limited by the capacity of the computer. The method is characterized by fully automatic operation including the reading in of data entered on punched tapes, computation of calibration curves and calculation of quench-corrected decay rates. This makes it possible to calculate decay rates of unknown samples with considerable accuracy within a short time. Programmable desk computers can also be connected to older models of liquid scintillation counters. (GE)

12779 EFFECT OF THIN ABSORBER ON FISSION-FRAGMENT DETECTOR CALIBRATION. Lerche, R. A.; Wehring, B. W. (Univ. of Illinois, Urbana). Nucl. Instrum. Methods; 114: No. 1, 137-138(1974).

The silicon surface-barrier detector calibration technique developed by Schmitt, which relates fission-fragment energy to pulse height, is shown to correct for energy loss of a fragment passing through a thin absorber. (auth)

12780 PLASTIC TRACK DETECTOR WITH HIGH SENSITIVITY. Lueck, H. B. (Zentralinstitut fuer Kernforschung, Dresden). Nucl. Instrum. Methods; 114: No. 1, 139-140(1974).

The sensitivity of a novel plastic track detector prepared from cellulose nitrate has been investigated. The track etching rate was determined in relation to the primary ionization rate. (auth)

12781 RESPONSE OF NE 111 SCINTILLATOR FOIL TO TRANSIENT ^{16}O IONS. Braun-Munzinger, P.; Gelbke, C. K. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Nucl. Instrum. Methods; 114: No. 1, 141(1974).

The response of a thin NE 111 scintillator foil to transient ^{16}O ions of energies between 15 and 60 MeV has been measured. (auth)

12782 EFFECTS OF FINITE DIMENSIONS IN SOURCE–DETECTOR SOLID-ANGLE EVALUATION. Belluscio, M.; de Leo, R.; Pantaleo, A.; Vox, A. (Univ., Bari, Italy). Nucl. Instrum. Methods; 114: No. 1, 145-147(1974).

Results for the solid angle subtended by a detector to a source, both circular cylinders, versus some values of the radii and the heights of the cylinders are presented. A method is suggested to evaluate self-absorption in the source. (auth)

12783 CALCULATION OF THE CORRECTED GEOMETRY FACTOR IN THE COINCIDENCE MEASUREMENT OF β^+-ANNIHILATION γ-RAYS. Nakajima, T. (Japan Atomic Energy Research Inst., Tokai). Nucl. Instrum. Methods; 114: No. 1, 149-151(1974).

The correction factor and corrected geometry factor, which are important in standardizing a β^+-emitting disc source by the β^+-annihilation γ-γ coincidence method, are calculated as a function of the source-to-crystal distance with the crystal- and source-radii as parameters. (auth)

12784 ESCAPE PEAK IN Si(Li) PLANAR DETECTORS. Dyson, N. A. (Univ. of Birmingham, Eng.). Nucl. Instrum. Methods; 114: No. 1, 131-133(1974).

The intensity of the escape peak from a lithium-drifted silicon detector is investigated using proton-induced characteristic x-rays. A theoretical calculation is also given, and good absolute agreement obtained. (auth)

12785 ADDENDUM TO "EFFICIENCY DETERMINATION FOR SOME STANDARD TYPE Ge[Li] DETECTORS FOR GAMMA-RAYS IN THE ENERGY RANGE FROM 0.04 TO 11 MeV". Seyfarth, H. (Kernforschungsanlag, Juelich, Ger.). Nucl. Instrum. Methods; 114: No. 1, 125-126(1974).

The experimental full energy peak efficiency curve of a 5.8 cm^3 planar Ge(Li) detector is compared with the curve obtained from the corrected semi-empirical formula of Paradellis and Hontzeas. (auth)

12786 MONTE-CARLO SIMULATION OF THE CAPTURE AND DETECTION OF NEUTRONS WITH LARGE LIQUID SCINTILLATORS. Poitou, J.; Signarbieux, C. (CEN, Saclay, Gif-sur-Yvette, France). Nucl. Instrum. Methods; 114: No. 1, 113-119(1974).

The capture and detection processes of neutrons in large gadolinium loaded liquid scintillators have been simulated using a Monte-Carlo program. The capture efficiency and also the probability of detecting a captured neutron depend on the initial energy of the neutron. The influences of the size of the tank and the location of the source are studied. It is shown that any increase of the efficiency leads to smaller variations of both the capture and γ detection probabilities over the energy range. (auth)

12787 PULSER-CONTROLLED DUAL WINDOW UNIT FOR USE IN GAIN STABILIZATION OF SCINTILLATION DETECTORS. Yamashita, M. (Electrotechnical Lab., Tokyo). Nucl. Instrum. Methods; 114: No. 1, 75-82(1974).

A highly stable dual-window unit is described, in which the thresholds of the three discriminators are controlled simultaneously by the use of reference pulses from a precision pulser. The principle of operation and the particular features of the operation of a basic threshold-control system are described in some detail. The threshold-control system assures high stability and reproducibility of the threshold and also compensates for the effect of baseline shifts. The pulser-controlled dual-window unit can serve as a basic reference element in gain stabilization of scintillation detectors, and as a usual pulse-height analyzer in counting experiments requiring great stability. (auth)

12788 NEUTRON-MULTIPLICITY SORTER FOR THE EXPERIMENTAL DETERMINATION OF $\bar{\nu}$. Worth, G. M.; Caldwell, J. T.; Dowdy, E. J. (Los Alamos Scientific Lab., NM). Nucl. Instrum. Methods; 114: No. 1, 71-74(1974).

An electronic circuit is described which, when presented with the discriminator-output pulses from a large, high-efficiency neutron-detection system, digitally sorts the number of pulses occurring in an adjustable count gate period and presents these data in both individual-line form to be recorded on a set of scalers and in analog form, suitable for analysis on a multichannel analyzer. This is accomplished through the use of modern integrated-circuit technology and, when using the analog output/multichannel-analyzer method of collection, greatly simplifies the taking and presentation of the data. The sorter electronics consists of one printed-circuit board mounted in a 3-inch wide NIM module and operates from the ±12V dc supply available from a standard NIM electronic bin. (auth)

12789 USEFULNESS OF MICA AND QUARTZ TRACK DETECTORS AT HIGH ENVIRONMENTAL TEMPERATURES. Khan, H. A. (Univ. of Birmingham, Eng.). Nucl. Instrum. Methods; 114: No. 1, 61-63(1974).

The track registration and retention characteristics of Muscovite mica and fused quartz (vitreosil) Solid-State Nuclear Track Detectors (SSNTDs) have been studied at high environmental temperatures. A particular emphasis has been laid on the improvement of genuine to background track densities so that the detectors can be used for even low yield experiments. The experiments were carried out in the temperature range of 22°C to 900°C and the results show that fused quartz (vitreosil) and mica (muscovite) SSNTDs can be used with an almost 100% efficiency up to temperatures of ~500 and 400°C respectively. (auth)

12790 MEASUREMENT OF SMALL EFFECTIVE CROSS SECTIONS OF FISSION USING SURFACE BARRIER DETECTORS. Cabot, C.; Ngo, C.; Peter, J.; Tamain, B. (Laboratoire de Chimie Nucleaire, Orsay, France). Nucl. Instrum. Methods; 114: No. 1, 41-48(1974). (In French).

The use of surface barrier detectors for the detection of fission fragments is difficult when the number of fragments is small relative to a large number of other charged particles, which may produce other coincidence events (random or true). It is especially difficult when the fragments' kinetic energies do not differ very much from those of the other charged particles. From the measured kinetic energies of the coincident particles and the kinematics of fission in the laboratory system the time-of-flight from the target to the detector for each particle and the difference in time-of-flight for each coincident event were calculated. If this event is due to fission and the fragment energies are correctly measured, this calculated difference must be equal to the measured time-of-flight difference. This selection method was applied to the fission of medium targets induced by 128 MeV ^{14}N ions, and it proved to be very effective and easy to handle. In addition, this method eliminates most of the random coincidence events. The remaining part of random events is lower by an order of magnitude than it would have been with the usual fast coincidence method; moreover, this part is easily measured. (auth)

12791 VELOCITY DEPENDENCE OF THE PHOTOMETRICALLY DETERMINED TRACK WIDTH OF HEAVY IONS IN ILFORD G5 NUCLEAR EMULSION. Larsson, L.; Andersson, R.; Mathiesen, O. (Univ. of Lund, Sweden). Nucl. Instrum. Methods; 114: No. 1, 35-39(1974).

The relation between the photometrically determined track width, W, and the velocity β of some heavy ions with charge numbers Z = 14, 16, 24 and 26 has been established in Ilford G5 nuclear-research emulsions. It has been found that in the velocity interval $0.4 \leq \beta \leq 0.8$ the relation between W, Z and β can approximately be written as $W(\beta,Z) = W_0(Z)\beta^{-\alpha(Z)}$. The numerical value of $\alpha(Z)$ is about one. From the empirical function $W(\beta,Z)$ we have derived the rate of change of W along the track. (auth)

12792 SOLID-ANGLE CORRECTION FACTORS FOR Ge(Li) DETECTORS. Roy, A.; Iyengar, K. V. K. (Tata Inst. of Fundamental Research, Bombay). Nucl. Instrum. Methods; 114: No. 1, 29-33(1974).

A method for calculating finite solid-angle correction factors for coaxial and five-sided Ge(Li) detectors is presented. This method is applicable to full energy peaks in the energy range where photoelectric interaction is dominant and to double escape peaks in the energy range where pair production is dominant. A computer program has been developed for this purpose in FORTRAN language for the CDC 3600 computer. (auth)

12793 APPARATUS FOR MEASURING THE NEUTRON FLUX IN A NUCLEAR REACTOR. Klar, E. (to Siemens Aktiengesellschaft). US Patent 3,780,292. 18 Dec 1973. Priority Date 16 Sep 1969, F. R. Germany. 2p.

The apparatus for measuring the neutron flux in the active region of a nuclear reactor has a plurality of individual neutron absorbing probes insertable into the active region of the reactor. One of the probes extends over the entire length of the active region and the remainder of the probes extend over progressively shorter lengths of the active region. The probes have respective portions outside of the active region and a cable connection means is connected to these portions. (Official Gazette)

Radiation Dosimeters

Refer also to abstract 13331.

12794 FAST-NEUTRON RESPONSE CHARACTERISTICS OF TSEE DOSIMETERS. Becker, K.; Razek, M. A. E. (Oak Ridge National Lab., TN). Nucl. Instrum. Methods; 113: No. 4, 611-614(1973).

Further applications are described of the previously reported technique of fast neutron dosimetry with combinations of hydrogenous radiators and ceramic BeO, to be evaluated by thermally stimulated exoelectron emission (TSEE). For example, a pronounced directional response has been minimized with a dosimeter–radiator–dosimeter sandwich; and information on the effective neutron energy can be obtained by varying either the radiator thickness, or the thickness of an absorber layer between radiator and TSEE dosimeter. (auth)

12795 PRODUCT SENSITIVE TO HIGH ENERGY RADIATIONS. Mercier, C. A.; Page, E. M. (to Societe Kodak-Pathe). French Patent 2,139,725. 2 Jun 1971. 13p. (In French).

A product sensitive to high energy radiations is proposed which contains a compound liberating an acid when the product is exposed to this radiation and a methinic dye which is bleached by the acid liberated. In order to quantitatively determine the exposure from high energy radiation, the variations in optical density produced in a dosimeter are measured. The quantity of acid liberated is a function of the exposure and the bleaching of the dye is a function of the quantity of acid liberated. Normally, the reduction in the density of the dye is proportional to the exposure. Such dosimeters include cyanines, merocyanines, hemicyanines, carbocyanines and dicarbocyanines, oxonol and styryl dyes being used as dyes for the spectral sensitizing of photosensitive silver halide emulsions. (FR)

12796 ASPECTS IN PRACTICAL NEUTRON DOSIMETRY WITH IONIZATION CHAMBERS. Kuehn, H. (Gesellschaft fuer Strahlen- und Umweltforschung mbH, Frankfurt am Main). Biophysik; 10: No. 3, 229-234(Oct 1973).

The calibration procedure to determine the absorbed dose within a phantom irradiated with fast neutrons is described for ionization chambers. A comparison between values of the neutron dose determined with paired ionization chambers and values of the neutron fluence measured with a fission chamber (^{238}U) is given. The comparison indicates the energy variation of the fast neutrons within a phantom irradiated with 14 MeV neutrons. (GE)

12797 INTENSITY MEASUREMENTS OF BREMSSTRAHLUNG IN THE 200 TO 10 eV REGION. Mueller-Sievers, K. (Max-Planck-Institut fuer Biophysik, Frankfurt am Main). Biophysik; 10: No. 2, 163-175(1973). (In German).

Thermoluminescence in LiF single crystals offers the possibility of measuring the intensity of bremsstrahlung with energies down to about 13.5 eV. An apparatus was developed which permits the production of sufficiently intense x-ray continua with voltages of 600 to 10 V. The high sensitivity of LiF also for low-energy radiation made it possible to study the relation between the intensity of the ultrasoft x-ray continuum and tube voltage. The past experimental and theoretical studies showed varying results in this respect. The results of the present experiments allow the conclusion that the integral intensity of extremely low-energetic bremsstrahlung produced in solid-state anodes is proportional to the square of the effective tube voltage, i.e., the kinetic energy of the electrons striking the anode. (GE)

12798 POSSIBILITY FOR USE OF CERTAIN PLASTICS IN THE DOSIMETRY OF VERY HIGH DOSES. Nicolae, M. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 18: No. 7, 887-899(1973). (In French).

A systematic investigation of four polymers having relatively high sensitivity to ionizing radiation including cellulose nitrate acetate and polycarbonate and terephtalate polyethylene is presented. Thin sheets (30 to 200 μm) of these materials were investigated: the optical absorption variation in uv light (260 to 400 mμm) induced by irradiation to γ rays; the dependence of the optical absorption variation on the absorbed dose; the stability by conservation of the induced effect; and accuracy and reproducibility of dose measurement by this method. (auth)

12799 STUDY OF THE ELECTRICAL CONDUCTIVITY OF CELLULOSE ACETATE IN RELATION TO ITS USE AS A SOLID TRACK DETECTOR. Bourdeaux-Pontier, M.; Roux, F.; Bernard, P. J.; Briand, C. (Aix-Marseille II Univ.). Radioprotection; 8: No. 1, 37-49(1973). (In French).

An original method is proposed for determining the dose received by cellulose acetate irradiated with fission fragments or α particles. The method is based on the alteration occurring in the transverse electrical conductivity of the detector after irradiation and subsequent etching with soda. Such techniques enable very high doses of irradiation to be measured. (FR)

Nuclear Spectroscopic Instrumentation

Refer also to abstracts 12988 and 12990.

12800 (LA-UR-73-1656) COMPUTERIZED SYSTEMS FOR ULTRALOW TEMPERATURE POLARIZED NUCLEI TIME REVERSAL AND PARITY EXPERIMENTS. Handy, L. E.; Steyert, W. A. (Los Alamos Scientific Lab., N.Mex. (USA)). 1973. Contract W-7405-eng-36. 5p. (CONF-731112-15). Dep. NTIS $3.00.

From nuclear science symposium; San Francisco, California, USA (14 Nov 1973).

Experiments for studying nuclear polarization phenomena at ultralow temperatures require extreme precision in the collected data. The polarization of the applied field must be changed periodically and the data from gamma-ray spectra must be reduced as the experiment progresses. These experiments sometime run for days in order to obtain good statistical data and to reduce any errors induced by the system instrumentation. A computerized system used to automate the necessary control and data handling functions for this class of experiment is described. (auth)

12801 DESCRIPTION OF A PAIR SPECTROMETER USED TO STUDY THE SMALL-ANGLE SCATTERING OF HIGH ENERGY PHOTONS. Jarlskog, G. (Univ. of Lund, Sweden); Joensson, L.; Pruenster, S.; Schulz, H. D.; Willutzki, H. J.; Winter, G. G. Nucl. Instrum. Methods; 113: No. 2, 261-265(1973).

A pair spectrometer has been designed to detect and measure photons in the GeV region scattered into the angular range of 1 to 4 mrad with respect to a well-collimated, high-intensity bremsstrahlung beam. Since it was essential to know the scattering angle, the design makes a reconstruction of the conversion point possible. The momentum resolution for the experiment was ±1% and the angular resolution was ±0.25 mrad. (auth)

12802 INVESTIGATION OF THE REPRODUCIBILITY OF THE ^6Li SEMICONDUCTOR SANDWICH TECHNIQUE. Rickard, I. C. (Imperial Coll. of Science and Tech., London). Nucl. Instrum. Methods; 113: No. 2, 175-180(1973).

The object of this work was to investigate the effect of the background subtraction technique and the flux level on the accuracy and reproducibility of the ^6Li semiconductor sandwich technique. Four measurements of the same fast neutron spectrum were produced for three γ-flux levels and two different background fractions. It is concluded that satisfactory results can be obtained in γ-fluxes below 25 rads/h, provided that at least one measurement is made in a γ-flux of less than 10 rads/h. In addition, it was found that reproducible results were obtained from detectors having different background fractions and it is concluded that the method of background subtraction is satisfactory. (auth)

12803 NEUTRON SPECTROSCOPY IN THE ENERGY RANGE 10 TO 500 keV USING THE ^6Li SANDWICH DETECTOR. Rickard, I. C. (Imperial Coll. of Science and Tech., London). Nucl. Instrum. Methods; 113: No. 2, 169-174(1973).

Use of the Triton Analysis technique allows neutron spectrum measurements in the range (10 to 500) keV from the ^6Li semiconductor sandwich detector. The analysis of the experimental results depends upon a knowledge of the angular distribution of the Li(n, α)t reaction. By modifying the values of the angular distribution it has been possible to force agreement between spectrum results from the ^6Li sandwich detector and results from time-of-flight measurement. By comparing the results from the measurements of the same neutron spectrum it was possible to distinguish between errors introduced by the unfolding process and those introduced by the basic nuclear data. (auth)

12804 GAMMA SPECTRA EFFECT ON THE PERFORMANCE OF CONTROL-CALIBRATION DEVICES. Popov, E. P.; Vishnyakov, E. K. (Leningrad Mining Inst.). Geofiz. App.; No. 51, 159-162(1973). (In Russian).

For the elimination of errors caused by the change of the discrimination threshold of the apparatus, the construction of a control-calibration device is recommended. It exactly reproduces the γ spectra scattered in the rock studied by the selection of scattering material with atomic number Z close to Z_{ef} of the rock and eliminates the air gap between the probe device and the scatterer. (tr-auth)

12805 EVALUATION OF STABILITY OF SPECTROMETERS FOR STUDYING BOREHOLES. Utkin, V. J.; Burdin, Yu. E.; Sen'ko-Bulatnyi, J. N. Geofiz. App.; No. 51, 88-92(1973). (In Russian).

The development of nuclear physical methods of investigating boreholes has led to the creation of borehole spectrometers of different types and purposes. The construction of functional spectrometer circuits, to a large degree, depends on the selection of

the limits of the admissible instability of the width and position of the spectral channels on the energy scale. On the basis of the analysis of the possibilities of different nuclear physical methods of the investigation of boreholes the size of the permissible instability was evaluated for borehole spectrometers. (tr-auth)

12806 NUMERICAL TREATMENT OF γ SPECTRA USING A PROGRAMMABLE DESK CALCULATOR. Fedoroff, M.; Blouri, J.; Revel, G. (Centre d'Etudes de Chimie Metallurgique, Vitry, France). Nucl. Instrum. Methods; 113: No. 4, 589-593(1973). (In French).

The use of a semi-conductor detector in activation analysis leads to the treatment of γ spectra which contain much numerical data. The treatment of these spectra has been achieved on a small programmable desk calculator coupled to a punched-tape reader. The calculations are divided into programmed automatic steps (to search for the peaks and to integrate the peaks). Between these steps, the operator checks the results and directs the subsequent treatment. This comparatively cheap system has a simple and universal use. It is especially advantageous for laboratories in which each analysis is a peculiar case. The validity of the programs has been checked by reproducibility measurements of neutron activation analysis of aluminium. (auth)

12807 LARGE IONIZATION CHAMBER USED AS AN ALPHA SPECTROMETER FOR URANIUM/THORIUM DATING. Hoegberg, S. A. C.; Gustavsson, J. E. (Uppsala Univ.). Nucl. Instrum. Methods; 113: No. 4, 573-581(1973).

A 600-l ionization chamber used as an α spectrometer is described. The sample is ground to a grain size of less than 1 μm and sprayed onto an acetate sheet with an area of 2 m^2 forming the outer electrode. The resolution of the spectrum is ~220 keV fwhm (full width half maximum) for carbonate samples and ~150 keV fwhm for chemically purified uranium samples. The integral background is typically ~0.8 cpm between 4 and 5 MeV when the whole counter is used. A carbonate sample with a uranium content of 1 ppM yields 5 to 10 cpm in the same interval. The spectrum is recorded by a 256-channel pulse-height analyser. The counting gas, which is a mixture of argon and nitrogen, is purified continuously by circulating it over metallic copper of about 500°C and activated charcoal at −78°C. (auth)

12808 SUBTRACTION OF THE BACKGROUND AND AUTOMATIC PEAK IDENTIFICATION IN GAMMA-RAY SPECTRA OBTAINED FROM A Ge(Li) DETECTOR. Volkov, N. G. (Inst. for Physical and Chemical Research, Yamato, Japan). Nucl. Instrum. Methods; 113: No. 4, 483-487(1973).

The identification of the peak area of γ-ray spectra, obtained from a Ge(Li) detector, was made by means of a χ^2-test in the spectra, from which the background had already been subtracted. Preliminary subtraction of the background was done by a special procedure, similar to the process of differentiation in electronic circuits. After this operation the slow changing component was cut off, which corresponds to the subtraction of the background. The small residual background is similar to zero level restoration by a diode. This subtracting procedure does not use any information about peaks in the spectrum. After subtraction of the background, the identification of the peak area was made on the basis of counting rate deviation from zero. Then additional subtraction was done after identification. For this purpose the background in the peak area was represented by a polynomial of the third order, satisfying the boundary conditions at the end points of the peak. (auth)

12809 DEVELOPMENT AND PERFORMANCE OF A SOLAR HARD X-RAY SPECTROMETER. Van Beek, H. F. Utrecht; Rijksuniversiteit (1973). 87p.

Thesis.

The instrument incorporated in the ESRO TD-1A satellite is described. The aim of the experiment is to measure the spectral distribution and the intensity of the hard x-rays emitted by the hot plasma which appears in a solar flare region. The experimental techniques described are based on the use of a scintillation counter, combined with two solid state detectors and a passive shielding against background radiation. Detection of the solar photons is performed by the scintillation counter. The solid state detectors are incorporated to detect charged particles which enter via the entrance window and might penetrate into the scintillation crystal. Preflight calibrations have been performed with the help of monoenergetic photons emitted by radioactive sources. Three examples of solar flare observations are given. (IAA)

12810 A PNEUMATIC SAMPLE CHANGER FOR GAMMA-RAY SPECTROSCOPY. Massoni, C.J.; Fones, R.V.; Simon, F.O. (U. S. Geological Survey, Washington, D. C. 20244). Rev. Sci. Instrum. 44: No. 9, 1350-1352 (Sept 1973).

A gravity-feed, pneumatic-ejection sample changer has been developed. The changer is suitable for both flat and well-type detectors and permits the continuous use of gamma-ray spectroscopy equipment 24 h a day, 7 days a week. The electronic circuitry has a fail-safe feature which stops the operation of the changer if a malfunction occurs. (auth)

12811 THE PARALLEL PLATE CONDENSER AS A RELATIVISTIC PARTICLE ANALYZER. Proca, G.A. (European Space Research Institute (ESRIN) of the European Space Research Organisation (ESRO), Frascati, Italy). Rev. Sci. Instrum. 44: No. 9, 1365-1375 (Sept 1973).

A fully analytical study of the properties of the parallel plate electrostatic spectrograph in the relativistic region is presented. The formalism used allows for an exact tridimensional treatment whereby the coupling between the polar angles θ, ϕ appears through the quantity $\alpha = -d\phi/d\theta$ only while the explicit expression of $\alpha(\theta, \phi)$ remains unspecified. This freedom in the choice of the relationship $\phi = f(\theta)$ may be used to improve on the properties of the instrument. The main consequence of the relativistic effect is to alter the shape of the focal surface in a way which reduces the versatility of the instrument when changes in energy range are considered. This stems from the dependence of θ, ϕ on $\beta = v/c$ introduced by the second order focusing condition. It is shown that versatility is restored to a considerable extent for suitable choices of $\phi = f(\theta)$. The relative merits of various choices are discussed. A numerical calculation of the basic parameters of a spectrograph suited for astrophysical research is given stressing the possibility of flying such an instrument aboard a space shuttle within the Post Apollo program. (auth)

12812 MINIMIZATION OF FRINGING FIELD EFFECTS IN THE PARALLEL PLATE ELECTROSTATIC SPECTROGRAPH. Proca, G.A. (European Space Research Institute (ESRIN), Frascati, Italy); Rüdinger, C. Rev. Sci. Instrum. 44: No. 9, 1381-1386 (Sept 1973).

The effects of fringing fields at the entrance and exit windows of the parallel plate electrostatic particle analyzer on the trajectory of particles is studied taking into account the finite thickness of the condenser plate bearing the windows. The influence of the physical dimensions of the spectrograph on the field variation is assessed together with that of a grounded plate parallel to the condenser and located in the entrance-exit region. A set of inequalities expressed in terms of the physical dimensions of the instrument is deduced to define a reference model spectrograph of known characteristics and minimal electric field distortion with the help of which any actual instrument may be studied using the electrostatic scaling laws. (auth)

12813 GAMMA-RAY SPECTROMETRY FOR IDENTIFYING AND EVALUATING AEROSOLS OF NUCLEAR POWER REACTORS. Rodin, N. N.; Shmelev, L. V.; Borisov, N. B.; Dembrovskii, M. A. Meas. Tech. (USSR) (Engl. Transl.); 16: No. 7, 1049-1052(Jul 1973). Translated from Izmer. Tekh.; 16: No. 7, 61-63(Jul 1973).

The application of γ-ray spectroscopy for the identification and quantitative determination of γ-active aerosols gathered from different ventilation systems of a nuclear power reactor is described. The sampling of the exhaust air specimens was done with a type AFA-RMP-20 analytical filter pack. A 5 cm^3 Ge(Li) gamma spectrometer with a 4.6 keV resolution was used. Procedures and results are outlined. (WHK)

12814 2 Ge(Li)−6 NaI(Tl) DETECTOR SYSTEM FOR GAMMA-GAMMA DIRECTIONAL CORRELATION STUDIES. Eriksson, L.; Gidefeldt, L. (Univ. of Stockholm). Nucl. Instrum. Methods; 114: No. 1, 127-129(1974).

A multidetector system is described. Twelve Ge(Li) coincidence spectra as well as the associated twelve random-coincidence spectra can simultaneously be recorded. The over-all performance has been checked. (auth)

12815 COMMENT ON "THE USE OF A PILEUP REJECTOR IN QUANTITATIVE PULSE SPECTROMETRY". Rolle, R. (Physical Science Lab., Marshalltown, South Africa); Bartosek, J.; Masek, J. Nucl. Instrum. Methods; 114: No. 1, 121-123(1974).

The paper by Bartosek et. al. (Nucl. Instr. and Meth. 104(1972) 221) is commented on by Rolle. Rolle states that a 2 μs delay of linear pulses between a pileup rejector and an analog-to-digital converter requires that the deadtime signal of the rejector also be delayed for quantitative spectrometry. The comment is denied by Bartosek and Masek. (WHK)

12816 EXPERIENCE WITH PROTON RECOIL SPECTRUM MEASUREMENTS BY MEANS OF PROPORTIONAL COUNTERS AND THEIR EVALUATION WITH RESPECT TO NEUTRON SPECTRA. Albert, D.; Koepernik, H.; Vogel, W. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Kernenergie; 16: No. 9, 287-290(Sep 1973). (In German).

The counters used are described regarding their properties. The spectrometer electronic components permits the n-γ pulse

shape discrimination to be studied. The results of test measurements are given. Computational programs involving the following problems are reported: differentiation of apparatus spectrum and determination of response function for spherical counters in the case of weak wall effects. (auth)

12817 COLD-NEUTRON SPECTROMETER FOR INELASTIC-SCATTERING STUDIES. Castagno, G.; Coppo, M.; Demichelis, F.; Saitta, L.; Tartaglia, A. (Istituto di Fisica Sperimentale, Turin). Nucl. Instrum. Methods; 114: No. 1, 21-27(1974).

A description of the cold-neutron spectrometer which is operated in the CAMEN center at San Piero a Grado (Pisa) is given. The apparatus was designed for use in classical and quantum-fluid research. The neutron beam of the 5 MW Galileo reactor enters, after passing through a cold propane source, a rectangular guide tube, made of nickel mirrors. The dimensions of the tube have been optimized to give a maximum neutron current on the sample. The neutron-energy spectrum measured by the time-of-flight method confirmed the theoretical predictions. The average neutron flux in the beam is 7.7×10^5 n/cm^2 sec. The neutrons emerging from the tube are "chopped" by a rotor giving a burst of 100 μsec. These neutrons are scattered by the samples along a convenient flight path and are collected by scintillation detectors. The analyzer system consists of a PDP-11 computer with a special 8-input interface. (auth)

12818 BACK-SCATTER MOESSBAUER STUDIES USING CONVERSION ELECTRONS: ^{119}Sn. Yagnik, C. M. (Austin Science Associates, Inc., TX); Mazak, R. A.; Collins, R. L. Nucl. Instrum. Methods; 114: No. 1, 1-4(1974).

Recent improvements in Moessbauer backscatter detectors have led to a new level of performance for ^{119}Sn. The backscatter detectors, using 90% He–10% CH_4, count efficiently the conversion and Auger electrons which follow resonant capture. Unenriched SnO_2 powder gives a 950% effect above base line. (auth)

12819 DETERMINATION OF LONG-LIVED ALPHA-ACTIVE AEROSOLS ON THE BACKGROUND OF DAUGHTER PRODUCTS OF RADON AND THORON. Labushkin, V. G.; Popov, V. I.; Ruzer, L. S. Meas. Tech. (USSR) (Engl. Transl.); 16: No. 7, 1046-1048 (Jul 1973).

Translated from Izmer. Tekh.; 16: No. 7, 59-61(Jul 1973).

Alpha spectroscopy of long-lived alpha-active aerosols in a background of radon and thoron daughter nuclides is discussed. The technology and application of solid scintillation spectrometers and semiconductor spectrometers are briefly described. (WHK)

12820 GAMMA RAY TRANSMISSION GAUGE FOR DETERMINATION OF HEAVY AND LIGHT METAL LOADING OF FUEL ELEMENTS. Gozani, T. (Intelcom Rad Tech, San Diego, CA); Weber, H.; Segal, Y. Nucl. Mater. Manage.; 11: No. 3, 139-149 (Fal 1973).

From proceedings of the 14th annual meeting of the Institute of Nuclear Materials Management, Inc.; San Diego, CA (20 Jun 1973).

Multi-line gamma sources and a gamma-ray spectrometer were used to determine heavy and light metal loading of fuel rods. Knowing the absorption coefficients for the chosen lines and some geometrical factors and measuring the transmission of an unknown sample and a standard sample, the mass of heavy and light elements in the former relative to the corresponding masses in the known standard which has the same geometrical features as the unknown sample, can be determined. A prototype multiple gamma energy gauge has been built. This device has been optimized to the problem of determining the amount of Th loading in the HTGR fuel rods. Using a set of attenuation coefficients, which were known to an accuracy of about 2%, the absolute amount of the heavy elements (approximately 92 to 95% Th and 5 to 8% ^{235}U) was made in a 2-minute measurement to an average accuracy of 1.5%. Higher accuracies, if desirable, can be obtained by using better known standards. (auth)

High Energy Physics Instrumentation

Refer also to abstracts 13292, 13293, and 13325.

12821 (N–73-31406) MONTE CARLO SIMULATION OF THE NUCLEAR-ELECTROMAGNETIC CASCADE DEVELOPMENT AND THE ENERGY RESPONSE OF IONIZATION SPECTROMETERS. Final Report, 1 July 1970–30 Jun 1973. Jones, W. V. (Louisiana State Univ., Baton Rouge (USA). Dept. of Physics and Astronomy). 29 Jun 1973. 18p. (NASA-CR–133999). NTIS $3.00.

Modifications to the basic computer program for performing the simulations are reported. The major changes include: (1) extension of the calculations to include the development of cascades initiated by heavy nuclei, (2) improved treatment of the nuclear disintegrations which occur during the interactions of hadrons in heavy absorbers, (3) incorporation of accurate multi-pion final-state cross sections for various interactions at accelerator energies, (4) restructuring of the program logic so that calculations can be made for sandwich-type detectors, and (5) logic modifications related to execution of the program. (STAR)

12822 (RL-73-99) COMPUTER CONTROL OF THE HPD2 FLYING SPOT DIGITIZER. Hallowell, P. J.; Lawes, R. A. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). Sep 1973. 10p. (CONF-730736-1). Dep. NTIS (U. S. Sales Only) $3.00.

From software for control conference; Warwick, UK (17 Jul 1973).

The computer control system for the HPD2 automatic measuring machine for hydrogen bubble chamber film at the Rutherford Laboratory is described. Both the central IBM 370/195 and satellite DDP 516 computers are involved. The overall strategy to go from photographic film to stored digitizings is emphasized with no attempt to detail specific problems. (auth)

12823 APERTURE DETERMINATION FOR A MULTIPLE-MAGNET MOMENTUM SPECTROMETER-TELESCOPE. Green, P. J.; Nagy, T. A.; Magnuson, C. E. (Texas A and M Univ., College Station). Nucl. Instrum. Methods; 113: No. 2, 241-245 (1973).

The differential aperture has been calculated for a three-magnet momentum spectrometer-telescope which was designed for making absolute muon intensity measurements at all zenith angles from the vertical direction to the horizontal. Approximately one meter of solid iron is distributed over a distance of 1.8 meters. It is shown that the differential aperture as a function of the zenith angle depends strongly on the angle of tilt of the spectrometer-telescope axis and varies significantly with momentum. For comparison with other systems, the aperture obtained by using the A^2/l^2 approximation is 194 cm^{2}sr. (auth)

12824 DESCRIPTION AND PERFORMANCE OF AN INTERACTIVE BUBBLE CHAMBER ANALYSIS SYSTEM USING AN HPD. Mueck, H. J.; Nagel, H. H.; Selonke, F. (Univ., Bonn). Nucl. Instrum. Methods; 113: No. 2, 267-284(1973).

For large-statistics bubble chamber experiments it is important to have a very effective control of the data-taking and evaluation system with regard to measuring precision as well as data handling. Difficulties in both areas may have consequences for the loss of events or for other distortions of the results. Under these aspects an HPD-based analysis chain is described and the performance of the chain and the quality of the measurements are discussed. (auth)

12825 MEASUREMENT OF CHERENKOV RADIATION IN COMPRESSED SILICA POWDER. Linney, A. D. (Danish Space Research Inst., Lyngby); Hugon, L.; Stroot, J. P. Nucl. Instrum. Methods; 113: No. 2, 305-308(1973).

It has been proposed that compressed powders with small grain size compared to the wavelength of light might be used as Cherenkov radiators with refractive indices in a range which is not easily accessible by other means. Measurements of Cherenkov radiation produced in compressed fine grain silica powder by energetic pions are presented. The Cherenkov threshold velocities derived from these measurements are found to correspond to the refractive indices measured by conventional optical methods, which lie within the range 1.1 to 1.2. (auth)

12826 MEDIUM-SIZED NEON–HELIUM STREAMER CHAMBER. Lightfoot, J. A.; Breare, J. M. (Univ. of Durham, Eng.). Nucl. Instrum. Methods; 113: No. 2, 247-251(1973).

The construction of a streamer chamber of size $60 \times 60 \times 12.5$ cm^3 is described. The high-voltage pulse is derived from a Marx generator, which is used to charge up an intermediate capacitor. This capacitor has a water dielectric and is of low inductance, so that it can be quickly discharged to produce the short pulse required for the streamer chamber. Measurement of the pulse is by means of a capacitance probe attached to the earth electrode of the pseudo-coaxial system. The streamer length and diameter distributions are discussed. (auth)

12827 SOME CHARACTERISTICS OF PARTICLE TRACKS IN A NEON–HELIUM STREAMER CHAMBER. Lightfoot, J. A.; Hiti, K. A.; Breare, J. M. (Univ. of Durham, Eng.). Nucl. Instrum. Methods; 113: No. 2, 253-259(1973).

A streamer generation model, modified from that of Chikovani, is described and compared with experimental results. This model shows that the greatest sensitivity of the streamer density to ionization is expected when about 50% of all possible streamers, at a particular delay, are allowed to develop. Experiments show

that the deviation of streamers from the track center is much less than that predicted by elementary diffusion and is dependent on the operating conditions of the chamber. The accuracy of the streamer chamber as a device for locating particle tracks is also investigated and the theoretical model is used to predict the systematic error produced by the shift of the streamer centers from the position of the original avalanches. (auth)

12828 CONSTANT CURRENT REGULATOR FOR FAST RECHARGING OF HIGH VOLTAGE ENERGY STORAGE CAPACITORS. Findley, R. W.; Russ, J. S. (Carnegie-Mellon Univ., Pittsburgh). Nucl. Instrum. Methods; 113: No. 4, 615-617(1973).

A circuit to linearize the charging curve of a capacitive load discharged by a spark gap or thyratron is reported. Use in spark chamber experiments is described. (auth)

12829 MAGNETIC MULTIPARTICLE SPECTROMETER USING DIGITIZED CYLINDRICAL SPARK CHAMBERS. Ficenec, J. R. (Virginia Polytechnic Inst. and State Univ., Blacksburg); Stringfellow, B. C.; Collins, G. B.; Ramanauskas, R.; Schuebelin, P.; Turkot, F. Nucl. Instrum. Methods; 113: No. 4, 535-540 (1973).

The construction and performance of the vertex spectrometer in the Multiparticle Argo Spectrometer System (MASS) used at Brookhaven are described. Nine digitized cylindrical wire spark chambers, surrounding a hydrogen target and operating in a 10 kG magnetic field, detected most charged particles with high efficiency up to multiplicities of 12. (auth)

12830 1973 INTERNATIONAL CONFERENCE ON INSTRUMENTATION FOR HIGH ENERGY PHYSICS. Proceedings. Conference held in Frascati, Italy, May 8-12, 1973. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973). 754p. (CONF-730531-).

A separate abstract was prepared for each of the 128 papers presented at the conference. (WHK)

For abstracts of individual papers see: 12773, 12774, 12831-12942, 13292, 13293, 13308, 13309, and 13320-13329.

12831 STATUS AND PROBLEMS OF LARGE BUBBLE CHAMBERS. Reinhard, H. P. (CERN, Geneva). pp 3-12 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

The large bubble chamber under construction or completed in 1970 is listed, and their main characteristics and some problems in design and operation are summarized. (WHK)

12832 STATUS AND PROBLEMS OF LARGE BUBBLE CHAMBERS: REVIEW A LARGE BUBBLE CHAMBER: Gargamelle, SKATT, Mirabelle. Prugne, P. (CEN de Saclay, Gif-sur-Yvette, France). pp 13-20 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

The heavy liquid bubble chamber SKATT at Serpukhov, the heavy liquid bubble chamber Gargamelle at CERN, and the hydrogen bubble chamber Mirabelle at Serpukhov are discussed. Vessel shapes and dimensions and other specification data are given. (WHK)

12833 TRACK SENSITIVE TARGETS AND RAPID CYCLING BUBBLE CHAMBERS. Fisher, C. M. (Rutherford High Energy Lab., Chilton, Eng.). pp 21-37 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

The design, operation, and uses of track sensitive targets in bubble chambers are discussed, and the design, operation, and performance of rapid cycling bubble chambers are reviewed. (WHK)

12834 EXPERIENCE WITH SMALL ULTRASONIC BUBBLE CHAMBERS. Brown, R. C. A.; Hilke, H. J.; Jarman, P. D. (CERN, Geneva). pp 38-40 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

Track sensitivity to minimum ionizing particles has been achieved in liquid hydrogen, as previously in helium, by using only intense ultrasonic fields. Present limitations and possibilities are discussed; in particular, implications for a possible chamber with $\sim 10^6$ sensitive cycles per second are considered. (auth)

12835 DEVELOPMENT OF THE LIQUID HYDROGEN ULTRASONIC BUBBLE CHAMBER IN DUBNA. Grebinnik, V. G. (Joint Inst. for Nuclear Research, Dubna, USSR); Manych, A. P.; Selivanov, G. I.; Shestakov, V. D.; Tkachev, L. G.; Zhukov, V. A.; Akulichev, V. A.; Alekseev, V. N.; Kopova, A. M.; Krasilnikov, V. A.; Yushin, V. P. pp 41-43 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

The results of experimental and theoretical studies of track formation in liquid hydrogen bubble chambers under the effect of ultrasound are given. Some physical phenomena on vapor bubble dynamics are considered. (auth)

12836 REPORT ON FAST CYCLING BUBBLE CHAMBERS AT SLAC. Watt, R. D. (Stanford Univ., CA). pp 44-49 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

The 40- and 15-inch fast cycling bubble chambers at SLAC are described, and their dynamics of operation discussed. The 40-inch chamber runs routinely at 10 pulses per second and has taken 85 million pulses and 18 million pictures. Its best use lies in hybrid experiments in which a reasonably high degree of selection is exercised and a pulse-to-picture ratio of several hundred-to-one is maintained. The 15-inch chamber is still in the stage of development. It is hoped that this chamber will ultimately be capable of pulse rates from 45 to 60 times a second, making it feasible to take several thousand pulses per picture. The 15-inch chamber has a superconducting Helmholtz coil which provides an 18 kG field and has what amounts to a 120 degree beam entrance window, with a beam exit window of the same aperture. (WHK)

12837 RAPID CYCLING BUBBLE CHAMBER WITH GOOD ACCESS FOR USE WITH COUNTERS. Newport, R. W.; David, D.; Diplock, B. R.; Edwards, B. W. H.; Turner, W.; Wheatley, J. D. (Rutherford High Energy Lab., Chilton, Eng.). pp 50-55 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

A rapid cycling bubble chamber to operate at 60 Hz, with up to 3π steradians available for viewing by external particle detectors is being developed. The basis of the design, the current specification, and the development program are described. (auth)

12838 MISSING-MASS TRIGGER FOR A BUBBLE CHAMBER. Dzierba, A. R. (California Inst. of Tech., Pasadena); Ford, W. T.; Gomez, R.; Oddone, P. J.; Peck, C. W.; Rosenfeld, C.; Ely, R. P.; Grether, D. R. pp 56-59 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

A method used to selectively photograph events in a bubble chamber is described. The reaction under investigation was nucleon diffractive dissociation by 14 GeV/c pions for which the principal signature is a fast forward-going pion and the main trigger background is elastic scattering. The scattered pion was measured in a wire spark chamber magnetic spectrometer and the mass left in the bubble chamber was computed. If the detected event was not elastic, the chamber lights were flashed. The trigger enriched the yield from about 1 event of the desired kind in 20 pictures to about 1 in 3. Furthermore, only 25% of the two-prongs were elastic scatters. (auth)

12839 OPERATION OF TRACK SENSITIVE HYDROGEN TARGETS IN A NEON HYDROGEN BUBBLE CHAMBER. Leutz, H. (CERN, Geneva); Williams, P. R. pp 60-65 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

Two track sensitive targets have been successfully operated in the 1.5 m cryogenic bubble chamber at the Rutherford High Energy Laboratory. The first target was of composite stainless steel and plexiglas construction, the second was made wholly of plexiglas. The bubble chamber was filled with mixtures of neon and hydrogen with neon concentrations in the range 43 molecular percent to 82 molecular percent. Chamber operating conditions were achieved which gave satisfactory track quality in both the target and the chamber over the neon concentration range investigated. A total

of >1.5 × 10^6 pictures for HEP research have been taken with this system. (auth)

12840 GEOMETRICAL RECONSTRUCTION OF EVENTS IN A TRACK SENSITIVE TARGET. Guy, J. G. V.; Fisher, C. M.; Chapman, W. S.; Wignall, W. (Rutherford High Energy Lab., Chilton, Eng.). pp 66-70 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

The modifications of the bubble chamber geometrical reconstruction program necessary to reconstruct track sensitive target (TST) events are described. The measurement system employed at the Rutherford Laboratory is outlined and results obtained on fiducial and track measurements are given. It is shown that helix fit residuals in hydrogen are reasonable and consistent with the conventional measurement technique employed. Preliminary results from reconstructing π^0s are given. (auth)

12841 OPTIMIZATION OF SIZE, SHAPE, AND POSITION OF A TRACK SENSITIVE H_2/D_2 TARGET FOR NEUTRINO INTERACTIONS IN BEBC. Haidt, D.; Leutz, H.; Wenninger, H. (CERN, Geneva). pp 71-78 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

At the neutrino energies which will be available in the future from the CERN 300-GeV accelerator for interaction studies, roughly ⅓ of the emerging hadronic energy goes into neutral pions. Therefore, efficient gamma detection becomes inevitable to determine the a priori unknown neutrino energies. In a track sensitive H_2/D_2-target (TST) the neutrino collisions occur on free protons or on quasifree neutrons and the surrounding neon-hydrogen mixture provides excellent gamma detection. Such a device inside the Big European Bubble Chamber (BEBC) could largely improve the physics output from future neutrino experiments and would, at the same time, sensibly reduce the amount of deuterium otherwise needed to fill the entire chamber. FAKE studies were carried out to optimize size, shape and position of a TST inside BEBC. The technical feasibilities in terms of operating conditions, track visibility and TST-construction are discussed. (auth)

12842 PERFORMANCE OF THE SUPERCONDUCTING FIELD SHIELDING TUBE FOR THE CERN 2 METER HYDROGEN BUBBLE CHAMBER. Firth, M.; Haebel, E. U.; Krempasky, L.; Schmeissner, F. (CERN, Geneva). pp 79-84 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

A superconducting shielding tube to provide a field-free bore 15 cm diameter, 230 cm long through the fringe field of the CERN 2 meter Hydrogen Bubble Chamber has been built and successfully operated with the chamber at full field. Design and construction of the device are described and the results of field measurements in the bore during operation are presented. (auth)

12843 INCREASE IN EFFICIENCY IN GARGAMELLE AND VIBRATION PROBLEMS. Gregoire, R. (CERN, Geneva). pp 85-86 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

Improvements to the Gargamelle bubble chamber are discussed including improvements to the grove valves, membranes, and liquid cleanliness and filtration system. Also, vibration problems are briefly discussed. (WHK)

12844 FIRST OPERATION OF BEBC. pp 87 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

The operating parameters and performance of the first run of the Big European Bubble Chamber (BEBC) from January to March 1973 are outlined. (WHK)

12845 MEASUREMENT AND RECONSTRUCTION OF THE BEBC MAGNETIC FIELD MAP. Haebel, E. U.; Wenninger, H.; Wittgenstein, F. (CERN, Geneva). pp 88-91 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

The superconducting magnet of the Big European Bubble Chamber (BEBC) has been excited with currents up to 5035 A corresponding to a magnetic induction of 3.1 Tesla at the center of the chamber. Since one expected that during the charging of the magnet coils, long time constant eddy currents would be induced by the varying radial field components, a system of 181 Hall-probes was installed on the boundary of the chamber body allowing to survey the magnetic field map. This Hall-probe system together with an NMR-probe (nuclear magnetic resonance) enabled us to measure and reconstruct to an accuracy of better than 0.1% the field map of BEBC, which in itself is uniform to within 3% inside the visible fiducial volume of the chamber. Direct evidence was also given for field map distortions due to the eddy current field which amounted to about 0.7% of the maximum recorded field values at the chamber center. (auth)

12846 PARAMETERS AND PERFORMANCE CHARACTERISTICS OF THE ARGONNE NATIONAL LABORATORY 12-FOOT BUBBLE CHAMBER. pp 92-100 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

A brief history of the ANL 12-foot bubble chamber is given, including a description of the design and operation. Topics include liquid volume, optics, expander, magnet, cryogenics, control room, reconstruction, and particle beam for the bubble chamber. (WHK)

12847 HYBRID BUBBLE-CHAMBER DETECTION OF NEUTRINO EVENTS: THE EXTERNAL MUON IDENTIFIER. Hawaii-LBL Collaboration. Contract AT(04-3)-511. pp 101-103 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

High energy neutrino interactions in hydrogen, in particular deep inelastic scattering $\nu p \rightarrow \mu p y^+$ (y^+ = any meson system) will be studied at NAL using the 30-m^3 bubble chamber as soon as the chamber is working and the neutrino beam is sufficiently intense. Identification of the muon is fundamental in the analysis of each event. Kinematic analysis often has been sufficient for muon identification in simple topologies with low energy neutrinos. As the neutrino energy increases and the event becomes more complex, however, it is necessary to require more positive identification of the muon among many outgoing prongs. The external muon identifier (EMI) was proposed by the LBL-Hawaii collaboration to meet this need. NAL "Experiment 155" is the development and test of the EMI as part of the 15-foot bubble-chamber facility at NAL. The EMI is basically an array of multiwire proportional chambers (MWPC) located behind the bubble chamber over a large enough area (30 m^2) to intercept most of the muons emerging from neutrino interactions in the hydrogen fiducial volume. Muons are distinguished from strongly interacting particles by their non-interaction in the 3.2 collision lengths of material (magnet coils, a "bellyband" absorber, chamber walls) between the hydrogen and the EMI. Extrapolation of the bubble-chamber tracks to the EMI yields the predicted position of a muon: if the particle "hits" the EMI (within multiple-scattering limits), it is called a "muon". If no hit is detected within the "muon circle," then it is not a muon. (WHK)

12848 PROGRESS IN STREAMER CHAMBERS. Meyer, H. (Deutsches Elektronen Synchrotron, Hamburg). pp 107-114 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

Properties of streamer chambers important for its use in high energy experiments are summarized. Several specific examples are discussed to illustrate the broad range of possible applications. (auth)

12849 STREAMER CHAMBER. Villa, F. (Stanford Univ., CA). pp 115-125 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

Recent technical improvements in the field of streamer chamber hardware are described. The accuracy and resolution of the SLAC 2-meter chamber are discussed in some detail, together with other streamer chamber facilities now operational. Few suggestions for future improvements are given. (auth)

12850 PROGRESS IN FLASH-TUBE AND OTHER HODOSCOPE CHAMBERS. Conversi, M. (Univ., Rome). pp 126-146 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

Hodoscope chambers (HC) have been employed extensively in cosmic ray experiments to fulfil the need of low-cost track detectors of large collecting area. Recently, however, improvements in flash-tube characteristics and the development of the "plastic chamber" have opened new possibilities for applications to experiments with particle accelerators as well. The work which led to these recent improvements and developments is briefly reviewed. The main features which at present make it appear that the HC an interesting tool not only for cosmic ray research, but also for nuclear and particle physics are summarized. Some limitations, with recent improvements, are listed. In particular the appealing possibilities of the most recent type of honeycomb structured plastic chamber are discussed briefly. (39 references) (WHK)

12851 TWO STEAMER CHAMBERS IN THE CERN HYPERON BEAM. pp 147-148 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

Two streamer chambers have been fabricated and have operated in the CERN negative hyperon beam since January 1972. Their characteristics are briefly presented. Streamer chambers have been used mainly in electron beams. The operation of two streamer chambers in a hyperon beam at the CERN P. S., with a high background level, is described. (auth)

12852 DEVELOPMENT OF A LARGE STREAMER CHAMBER FOR THE INTERSECTING STORAGE RINGS AT CERN. Eckardt, V.; Gebauer, H. J.; Meinke, R.; Sander, O. R. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). pp 149-153 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

A streamer chamber system has been constructed surrounding as completely as possible one of the intersection regions of the CERN Intersecting Storage Rings. The system consists of two identical streamer chambers with ground electrodes shaped to fit the vacuum tubes of the storage rings. To detect photons, lead oxide plates have been inserted into the sensitive volume of the chambers. To have a very short and constant memory time, a system which measures and regulates the memory time within a few percent is used. (auth)

12853 EIGHT-METER STREAMER CHAMBER OPERATING ON THE IHEP PROTON SYNCHROTRON (SERPUKHOV). Anisimova, N. Z.; Veremeev, M. M.; Davidenko, V. A.; Dolgoshein, B. A.; Kantserov, V. A.; Kirillov-Ugryumov, V. G.; Lebedev, A. N.; Miroshnichenko, V. P.; Rogozhin, A. M.; Staroseltsev, V. N.; Somov, S. V. (Moscow Engineering-Physics Inst.). pp 154-156 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

The design and performance of an 8-m streamer chamber as well as the pulse shaping and photography systems used are discussed. (auth)

12854 JINR 2m STREAMER CHAMBER. Vardenga, G. A.; Volodin, V. D.; Glagoleva, N. S.; Karzhavin, Yu. A.; Kuznetsov, P. S.; Lukstinyah, Yu.; Matyushin, A. T.; Matyushin, V. T.; Mescheryakov, M. G.; Okonov, E. O.; Khorozov, S. N. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 157-160 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

The JINR 2-meter streamer chamber is described, and performance testing results are discussed. (WHK)

12855 MULTIPLE FIRING OF A STREAMER CHAMBER CONICAL BLUMLEIN LINE. Rohrbach, F. (Univ. of Washington, Seattle). pp 161-170 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

Very fast rise time (≤0.4 ns) low amplitude jitter (<1%; no observable pulse height variation on an oscilloscope trace) has been successfully obtained by the use of an axial spark gap feeding a conical 25Ω Blumlein line. The triggering effect of the axial spark gap allows several radial spark gaps to fire simultaneously with no measurable jitter. Both the conical geometry of the lines and the multiple gaps (3 are used) result in a very fast rise time of the Blumlein high voltage pulse. The full length of the pulse (at the base) can then be decreased to ~4 ns without loss in pulse amplitude. Both the amplitude jitter and the rise time have been found to depend on the kind of gas. The system has been fired more than 30,000 times at voltages up to 550 kV without apparent damage. The fastest pulse was obtained with argon up to 200 kV. This high voltage system will be used for the University of Washington missing mass streamer chamber spectrometer. (auth)

12856 UNIVERSITY OF WASHINGTON STREAMER CHAMBER SPECTROMETER. Cook, V.; Gregg, R.; Jonckheere, A. M.; Kenyon, R.; Lubatti, H. J.; Rohrbach, F. (Univ. of Washington, Seattle). pp 171-180 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

A missing mass spectrometer for the study of diffractive dissociation at NAL is described. The central element of the spectrometer is a helium-streamer chamber which will be placed in a large aperture magnet. The streamer chamber gas (^{4}He) serves as the target. This makes possible accurate measurement of very low energy recoil α particles and good precision in the missing mass, as well as observation of the interaction vertex. An array of multiwire proportional chambers and scintillation counters will be used to trigger the system. A cylindrical Blumlein line capable of delivering pulses with a rise time less than 0.4 ns and full width of 4 ns has been tested, and a single-cell streamer chamber using wire planes has been designed and is under construction. (auth)

12857 IONIZATION MEASUREMENT WITH A STREAMER CHAMBER IN A QUARK EXPERIMENT. Eggert, K.; Guerich, W.; Smetan, E. (Technische Univ., Aachen). pp 181-183 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

Ionization measurements were performed in two 1 m long streamer chambers using different gas mixtures. The chambers were photographed with an image intensifier. The experimental set-up was used to search for quarks in high energy air showers. The ionization of the particles was evaluated from the streamer density and the streamer gap distribution. The accuracy obtained for a 25 cm long track was ±14%. This opens the possibility of identifying high energy particles with the help of the relativistic increase of the ionization. (auth)

12858 PLASTIC CHAMBERS. Conversi, M.; Federici, L.; Taccetti, Q. (Univ., Rome). pp 184-192 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

A new kind of electrically pulsed track chamber is described. The chamber is composed of sensitive elements of plastic material in which a noble gas mixture flows. Some general features are: ease of realizing large sensitive volumes of any geometrical shape; very low cost of construction and operation; high efficiency in detecting multi-track events; possibility of recording the information either optically, and in particular by TV systems, or electrically, by means of simple probes which yield pulses that need no amplification. Two particular versions of "plastic chamber" are described. One of them, made of honeycomb structured polypropylene, is characterized by lack of dead space; minimum amount of low Z insensitive material; space resolution in the mm region; and time resolution which can be adjusted from ~0.1 to ~10 μs per element by varying the rate of gas flow through the sensitive elements. At the preliminary stage of the investigation only recovery times ≥ ~50 ms have been obtained. (auth)

12859 INVESTIGATION AND IMPROVEMENT OF "FLASH TUBE HODOSCOPE" PROPERTIES. Bemporad, C.; Calvetti, M.; Cotantini, F.; Guidi, C.; Lariccia, P. (Univ., Pisa, Italy). pp 193-206 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

A large volume inexpensive track and shower detector, utilizing flash tube hodoscopes, is in construction for an experiment at the Italian Adone storage ring ($e^+e^- \rightarrow B\bar{B}$). Preliminary to this, a careful experimental study of flash tube properties has been performed to gain complete control of their characteristics and to guarantee the stability of operation. Different glasses, noble gas fillings, and electronegative gas contaminations were examined; also the effects of low voltage and gated high voltage clearing fields were thoroughly studied. 10,000 flash tubes (150 cm length, 11 mm diameter, 0.5 mm wall thickness) with their efficiency, sensitive time, and memory time fully compatible with their use in the planned experiment, are now in production. (auth)

12860 THEORY OF FLASH-TUBE RECOVERY TIME. Brosco, G. (Univ., Rome). pp 207-210 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

Some calculations are made to derive a simple expression for the flash-tube recovery time, taking into account the charge diffusion and recombination. A comparison of results with experimental values shows a fairly good agreement; the discrepancies are probably due to electronegative impurities always present inside the tube. (auth)

12861 EFFECTS OF IMPURITIES AND ALTERNATE ELECTRIC FIELDS ON FLASH-TUBE SENSITIVE AND RECOVERY TIMES. Brosco, G.; Cialdea, R.; Conversi, M.; Zolesi, B. (Univ., Rome). pp 211-214 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

The results of a further investigation on the sensitive and recovery times of a flash-tube "contaminated" with SF_6 impurities are reported. (auth)

12862 MEASUREMENT OF THE DECREASE IN FLASH TUBE RECOVERY TIME BY THE ADDITION OF OXYGEN. Breare, J. M.; Chaney, J. E.; El Disouki, W. (Univ. of Durham, Eng.). pp 215-217 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

A reduction of the recovery time from approximately 240 ms, for normal tubes filled with a neon helium mixture, to 30 ms is obtained by the addition of a small amount of O_2 to the rare gas mixture. The sensitive time and the light emission are also altered by the oxygen. (auth)

12863 CONTROL OF NEON FLASH TUBE SENSITIVE TIME BY THE USE OF ALTERNATING CLEARING FIELDS. Breare, J. M.; Chaney, J. E.; El Disouki, W. (Univ. of Durham, Eng.). pp 218-220 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

The sensitive time of flash tubes cannot be reduced by the application of dc fields but ac fields of approximately 50 Hz are shown to be successful. An estimate of the decay time of charges inside a flash tube is given. (auth)

12864 EFFECT OF GLASS RESISTANCE ON THE INTERNAL CLEARING FIELDS IN NEON FLASH TUBES. Breare, J. M.; Chaney, J. E.; El Disouki, W.; Lightfoot, J. A. (Univ. of Durham, Eng.). pp 221-223 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

The efficiency of flash tubes, at time delays greater than 1μs, depends on the resistance of the glass of the tube. The efficiency is highest for tubes of low resistance glass where clearing fields are small. The resistance of the glass is reduced at high temperatures. (auth)

12865 DIGITIZATION OF NEON FLASH-TUBES. Ayre, C. A.; Breare, J. M.; Thompson, M. G. (Univ. of Durham, Eng.). pp 224-226 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

A technique for the digitization of neon flash-tubes utilizing a simple probe on the front of the tube is described. It is shown that a satisfactory probe can be made from an 8BA screw or a suitable nail, positioned adjacent to the end of the flash-tube. The properties of the digitization pulse are described in terms of the physical characteristics of the system. (auth)

12866 LARGE ALUMINUM WIRE SPARK CHAMBERS WITH MAGNETOSTRICTIVE READ-OUT. Bradamante, F.; Conetti, S.; Daum, C.; Dechelette, P.; Fidecaro, G.; Fidecaro, M.; Giorgi, M.; Penzo, A.; Piemontese, L.; Renevey, M.; Schiavon, P.; Vascotto, A. (CERN, Geneva). pp 227-230 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

A set of wire spark chambers, with a sensitive surface of 300 × 100 cm^2 and 1 cm gap, has been constructed to detect backward-emitted particles in an experiment at the CERN PS. To reduce the multiple Coulomb scattering of the particles passing through the chambers, the electrodes were made of aluminium wires; furthermore, a crossed-wire configuration, giving two orthogonal coordinates per chamber, was adopted. The wire planes were pulsed by feeding the high voltage from strip-lines placed along the boundary of the chamber. The main features of the chambers are: (a) a light-weight mechanical structure, (b) uniform efficiency and good space resolution (≤0.4 mm) over a large surface, and (c) a minimum equivalent thickness of 6×10^{-4} radiation lengths. (auth)

12867 HIGH SPACE RESOLUTION CRYOGENIC SPARK CHAMBERS. Atac, M.; Taylor, W. E. (National Accelerator Lab., Batavia, IL). pp 231-234 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

A cluster of four narrow gap (2.5 mm) spark chambers containing 8 wires per millimeter has been built and operated at low temperatures (as low as −160°C). Results obtained from these chambers indicate that the width of the spark column is reduced at lower temperatures due to the increased gas density. Electron diffusion and deviation of the spark column from the true particle trajectory are greatly reduced at lower temperatures with narrow gap spark chambers. Space resolutions less than σ = 100 microns (HWHM) have been achieved. (auth)

12868 HOLOGRAPHIC FAST DETECTION OF ELECTRON TRACKS IN A HELIUM STREAMER CHAMBER. Kulyukin, M. M.; Stabnikov, M. B.; Tombak, M. A.; Shcherbakov, Yu. A. (Inst. of Nuclear Physics, Leningrad). pp 235-236 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

A method for holographic detection of charged particle tracks in a discharge chamber is described. A ruby laser was used for fast detection of electron tracks in a streamer chamber filled with helium at 1 atm. (WHK)

12869 CAN THE LASER TRACK CHAMBER COMPETE WITH THE STREAMER CHAMBER. Morrison, R. W. (Carleton Univ., Ottawa); Swail, C.; Dubal, L. pp 237-240 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

An attempt was made to detect cosmic ray tracks using a pulsed TEA CO_2 laser. This corresponds to making a streamer with the high voltage pulse generator replaced by a laser beam. Within 4 μsec of the passage of a cosmic ray through a pressurized cell, a laser beam of energy density 4J/cm^2 at 10.6 μ was fired. Pure argon and argon-krypton mixtures were studied at pressures up to 12 atm. Spots of light were seen but no tracks. Laser damage to the cell windows was the limiting factor. An alternative detector using an initial high voltage pulse followed by a laser pulse is proposed. (auth)

12870 POSSIBILITY OF RECORDING STREAMER-CHAMBER TRACKS WITH A TV SYSTEM. Cesaroni, F.; Florean, U.; Severi, M. (INFN, Rome). pp 241-243 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

A small streamer-chamber triggered by fast cosmic rays is in

operation at INFN Laboratories of Rome. It has been verified that data acquisition from sufficiently bright streamers by means of a commercial TV system is possible. Comparison between this method and the photographic one is made. Furthermore, the assembling of a new TV system with improved characteristics is in progress. (auth)

12871 FAST CAMERA FOR OPTICAL CHAMBERS. Mehlhop, W.; Piccioni, O.; Scipione, D.; Allen, P.; Bowles, P.; Garland, R.; Kobrak, H.; Marraffino, J.; Murty, S. pp 244 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

A camera to take pictures of spark chambers with time separations as short as 15 milliseconds for a frame length of one inch (35 mm) is described. The camera uses an electric generator to monitor the motion of the film and to command a printed motor to produce the accelerating and decelerating torque at the appropriate time. (auth)

12872 WIRE SYSTEMS. Charpak, G. (CERN, Geneva). pp 247-255 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

Multiwire proportional chambers, drift chambers, and projection chambers are discussed. (WHK)

12873 PROPORTIONAL CHAMBER WITH TWO-DIMENSIONAL READ-OUT USING DRIFT TIME AND CURRENT DIVISION. Baksay, L.; Boehm, A.; Bozzo, M.; Ellis, R.; Foeth, H.; Hammarstroem, R.; Kernan, A.; Naroska, B.; Staude, A.; Strolin, P.; Rubbia, C. (Technische Hochschule, Aachen). pp 256-258 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

Two readout techniques for proportional chambers with large wire distances and accurate position determination are discussed. The position of a particle is determined across the wires by drift time and along the wires by the ratio of the currents at both ends of the wire. The drift chambers described will in addition be required to measure ionization and will be used for quark search at the ISR. Also for application at the ISR a cylindrical chamber with two-dimensional readout is under construction. (auth)

12874 COMMENTS ON PARTICLE IDENTIFICATION USING THE RELATIVISTIC RISE OF IONIZATION ENERGY LOSS. Mulvey, J. H. (Nuclear Physics Lab., Oxford). pp 259-261 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

Two well known problems confront the experimenter wishing to use relativistic rise of ionization energy loss to assist in the identification of relativistic particles: (i) The increase in energy loss is logarithmic with energy and rather soon reaches a limit due to polarization of the medium (the density effect). (ii) The energy loss is subject to large fluctuations, first analyzed by Landau, and to obtain significant information the complete distribution has to be measured for each particle by taking many samples, say >100; this introduces considerable practical complexity. The density effect is least in gases and many investigations of energy loss as a means of particle identification have been made using gas proportional counters or multiwire proportional chambers. Some measurements of energy loss in xenon are reported, and a method of sampling the energy loss of relativistic particles in a gas is outlined. (auth)

12875 HYPERBOLIC PROPORTIONAL CHAMBERS. Criegee, L.; Franke, G.; Timm, U.; Zimmermann, W. (DESY, Hamburg). pp 262-263 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-

For detectors with cylindrical symmetry z, r, φ, there is a problem to detect the longitudinal coordinate. A proportional chamber in which the wires are tilted to the cylinder axis by a small angle, thus forming a hyperbolic surface is described. A unit of three such planes with angles of 0°, +8°, −8° has been built and tested. A successive set of such hyperbolic chambers supplies a complete stereo view in three coordinates for a track. (auth)

12876 OPERATION AND FURTHER DEVELOPMENT OF LARGE AREA DRIFT CHAMBERS. Walenta, A. H. (Univ., Heidelberg). pp 264-267 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

A system of drift chambers with a sensitive surface of 5 m^2 and a location accuracy of $\sigma = 0.35$ mm is described. These chambers have been operated from August 1971 to July 1972. By use of two drift chambers (one behind the other) the location accuracy can be improved considerably and the time resolution can be reduced to a few nanoseconds. The additional readout of the signals on the cathode wires offers the possibility of mirror image suppression (>90%) for double tracks by use of the drift time information. (auth)

12877 VERY LARGE PROPORTIONAL DRIFT CHAMBERS WITH HIGH SPATIAL AND TIME RESOLUTIONS. Cheng, D. C.; Kozanecki, W. A.; Piccioni, R. L.; Rubbia, C.; Sulak, L. R.; Weedon, H. J.; Whitaker, J. (Harvard Univ., Cambridge, MA). pp 268-274 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

The design, construction and performance of very large (16 m^2) drift chambers are described. Simultaneous accurate time (11 nsec) and position (0.35 mm) determinations are obtained by the use of a redundant number of planes suitably shifted relative to each other. (auth)

12878 INVESTIGATIONS ON THE OPERATION OF LARGE PROPORTIONAL WIRE CHAMBERS. Fischer, H. G.; Hilke, H. J.; Piuz, F.; Ullaland, O. (CERN, Geneva). pp 275-279 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

Several large proportional chambers to be used in the Split Field Magnet detector at the CERN Intersecting Storage Rings were investigated with respect to their operational characteristics. (auth)

12879 SYSTEM OF PROPORTIONAL CHAMBERS WITH 50,000 WIRES. Bouclier, R.; Charpak, G.; Chesi, E. (CERN, Geneva). pp 280-283 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

A multiparticle spectrometer at the CERN Intersecting Storage Rings is equipped with a proportional chamber detector. The construction of 20 modular 100 × 200 cm^2 wire chambers and the electronics for a 50,000 wire system is described. (auth)

12880 LOW MASS CYLINDRICAL MWPC FOR SIMULTANEOUS AXIAL AND AZIMUTHAL POSITION MEASUREMENTS ON MULTIPARTICLE EVENTS. Bizot, J. C.; Cordier, A.; Delcourt, B. (Univ. Paris-Sud, Orsay, France). pp 284-286 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

The construction and performance of a cylindrical proportional chamber with anode and cathode detection permitting simultaneous axial and azimuthal localization without ambiguity are described. The anode wires are strung parallel to the chamber axis, while the inner and outer cathode wires form helices inclined at + and −45°, respectively. The average chamber thickness is 10^{-3} radiation lengths. (auth)

12881 MADKA, A DETECTOR SYSTEM FOR EXPLORATIVE EXPERIMENTS. Mehrgardt, H. (DESY, Hamburg); Stoesser, G.; Waloschek, P.; Willutzki, H. J.; Winter, G. C.; Iarocci, E. pp 287-295 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

A set of cylindrical Charpak chambers (92% of 4π) provided with hardware-logic for track recognition and event classification has

been tested with cosmic-rays and is now installed at the ADONE Storage Ring. The performance of the system is described, in particular regarding the selection of multihadronic and monitor events and the rejection of cosmic-ray background. (auth)

12882 SENSE WIRE SUPPORT FOR LARGE MULTIWIRE PROPORTIONAL CHAMBERS. Breare, J. M. (Univ. of Durham Eng.); Short, K. A.; Smith, G. C.; Cunningham, R. A. pp 296-297 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

A support consisting of a thin melinex strip, with its plane perpendicular to the plane of the sense wires has been investigated and compared with a 200 μm nylon cord support. Results indicate that the dead space produced by the melinex is very similar in area to that produced by the nylon cord. (auth)

12883 MULTIWIRE PROPORTIONAL CHAMBERS FOR PHOTON BEAM EXPERIMENTS. Cunningham, R. A.; Gabathuler, E.; Sproston, M.; Taylor, D. G. (Daresbury Nuclear Physics Lab., Eng.). pp 298-300 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

The construction of a one plane chamber 180 mm × 510 mm and a three plane chamber 620 mm × 1330 mm is outlined. Both chambers have a gap width of 6 mm and a wire spacing of 2 mm. The performance of the chambers is described. (auth)

12884 VERY HIGH ACCURACY DRIFT CHAMBERS IN MAGNETIC FIELDS. Breskin, A. (CERN, Geneva); Charpak, G.; Sauli, F.; Duinker, W. pp 301-304 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

A suitable arrangement of the cathode wires' potential makes it possible to drift electrons produced by a charged particle in a multiwire chamber to an amplifying detection wire. With a proper choice of the field distribution and of the gas composition, a quasi-linear space-time correlation has been measured for long drift spaces which, through a time-of-drift measurement, allows one to deduce the space coordinate of a track with a typical accuracy between 50 and 200 μm. Chambers have also been operated in strong magnetic fields, with full efficiency as discussed in the text; a wire spacing around 5 cm seems a good compromise between an acceptable memory (about 500 nsec) and a small number of wires. (auth)

12885 HIGH-RESOLUTION LIQUID-FILLED MULTI-WIRE CHAMBERS FOR USE IN HIGH-ENERGY BEAMS. Derenzo, S. E.; Schwemin, A.; Smits, R. G.; Zaklad, H.; Alvarez, L. W. (Lawrence Berkeley Lab., CA). pp 305-312 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

Experiments with liquid-xenon-filled wire chambers operating in the proportional mode and the difficulty of achieving useful gain when the anode wires have a spacing <1 mm are described. As a result, attention has been directed to chambers with closely spaced wires operated in the ionization mode. The construction of two small high-resolution test chambers to be filled with liquid argon, krypton, or xenon is described. The chambers consist of two flat cathodes 1 to 2.5 mm apart with a wire plane between them. The wire plane is an array of 24 wires, 5 μ in diameter, spaced on 20-μ centers, and a charge amplifier is attached to each wire. The space resolution (expected rms <20 μ), time resolution (expected rms <50 ns), and efficiency will be measured in an accelerator beam. Chambers of this type with only a few hundred wires have sufficient area to cover nearly every beam at NAL. (auth)

12886 MULTIWIRE PROPORTIONAL COUNTER WITH 5 WIRES PER MILLIMETER. Dhawan, S.; Disco, A.; Sandweiss, J.; Souder, P. A. (Yale Univ., New Haven). pp 313-315 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

Some preliminary tests on a multiwire proportional chamber (MWPC) with wires spaced 200 μm apart are presented. This type of MWPC is being developed for use in a small angle elastic scattering experiment at NAL where the improved spatial resolution permits the construction of a compact spectrometer. (WHK)

12887 OPERATION OF LARGE DRIFT LENGTH CHAMBERS. Saudinos, J. (CEN de Saclay, Gif-sur-Yvette, France). pp 316-317 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

Large drift chambers are operated at the SPESI magnetic spectrometers in Saclay. This spectrometer works with the 1 GeV proton beam of the Saturne synchrotron and gives a 100 keV energy resolution. The dispersion of the spectrometer in 0.9 mm/100 keV at 1 GeV and the used length of the focal plane is 50 cm. To localize the exit trajectories, drift chambers with a 50 cm drift length able to give a linear resolution better than 0.9 mm over at least 20 cm are used. Performance requirements and experience with the drift chambers are briefly discussed. (WHK)

12888 ELECTRIC DELAY-LINE READ-OUT FOR MULTIWIRE PROPORTIONAL CHAMBERS. Bradamante, F.; Conetti, S.; Daum, C. (CERN, Geneva). pp 318-320 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

A compact electromagnetic strip-delay-line, obtained by multilayer printed circuit techniques, with good transmission properties was used for the readout of a multiwire proportional chamber by connecting the sense wires to the line at regular intervals. The impact position of a particle passing through the chamber was measured by the delay between the signals at the two opposite ends of the line. Tests made with a β source show that with simple electronics good efficiency and a space resolution better than the wire spacing can be obtained. Preliminary tests in a beam confirm the possibility of using such chambers as elements of hodoscopes for high rate conditions. (auth)

12889 GLOW MEMORY WIRE CHAMBER: A NEW TYPE WIRE CHAMBER FOR EFFICIENT READOUT OF MULTIPLE-TRACK EVENT. Kobayakawa, H.; Yamaki, T. (Nagoya Univ., Japan). pp 321-327 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

The glow memory wire chamber consists of three wire planes; the sensitive gap works as a conventional wire chamber and the memory gap (0.5 mm) composed of the X- and Y- wire planes holds glow discharges ignited by sparks on the sensitive gap. These glow discharges act as memory elements of original spark locations, and one can handle the correlated coordinates (address) of multiple tracks without ambiguity. The address can be easily and quickly read out; first by searching X-wires of which dc levels are changed due to glow discharge currents and next by emitting a sense signal to those wires and reading the signals on Y-wire transmitted through the conductive column of glow discharges. The results of tests with a chamber (15 × 15 cm) are as follows: the holding efficiency of the glow discharge was ~100%, the spatial resolution was similar to that of a conventional wire chamber and the transmission signal through the glow discharge was not distorted and attenuated. This signal was sufficient to read out with the conventional readout system. (auth)

12890 MACROSCOPIC THEORY OF TRANSITION RADIATION. Garibyan, G. M. (Erevan Inst. of Physics). pp 329-333 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

A review of the present theory of transition radiation is given. The properties of x-ray transition radiation mainly are considered. Using the general formula for the transition radiation of a charged ultrarelativistic particle passing through a laminar medium it is shown that in certain cases it can be reduced to a more simple form while in other cases it is necessary to use the general formula. All calculations are carried out taking into account the absorption in the medium. It is shown that in some cases the absorption influences not only the yield from the laminar medium in which the radiation is generated but also the radiation production itself. Formulas for the transition radiation produced in a plastic foam type nonperiodic medium are also obtained. An analysis of these formulas is carried out and it is shown that in certain cases the radiation will be identical to the radiation produced in a periodic medium. (auth)

12891 RECENT PROGRESS IN TRANSITION RADIATION DETECTOR TECHNIQUES. Yuan, L. C. L. (Brookhaven National Lab., Upton, NY). pp 334-349 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

A brief review of the principal characteristics of transition radiation is given and a list of some of the major experimental achievements involving charged particles in the relativistic region are presented. With the emphasis mainly directed to the x-ray region of the transition radiation, certain modes of application of the transition radiation for the identification and separation of relativistic charged particles are discussed. Some recent developments in detection techniques and improvements in detector performances are presented. Experiments have also been carried out to detect the "dynamic radiation", but no evidence of such an effect was observed within the sensitivity of the present experiments. (auth)

12892 EXPERIMENTAL INVESTIGATION OF TRANSITION RADIATION AND ULTRARELATIVISTIC PARTICLE DETECTORS. Alikhanyan, A. I. (Erevan Inst. of Physics). pp 350-355 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

The experimental results on the investigation of the x-ray transition radiation produced by 1.5 to 31 GeV electrons in laminar and foam media are given. On the basis of the experimental data the optimal parameters of the laminar medium and the detecting devices are determined. X-ray transition radiation detectors of various types which may be used for particle identification in accelerator and cosmic ray experiments at energies higher than 200 to 300 GeV have been constructed and tested. A large 120 × 120 cm^2 multiwire proportional chamber is planned to use in a cosmic ray experiment in which the identification of pions and protons with energies higher than 500 GeV will be realized by means of transition radiation. In out laboratory we have constructed a xenon scintillation counter and used it for the detection of x-ray transition radiation. By means of such an x-ray transition radiation detector having ~90% efficiency one may reject 500 GeV protons from pions. (auth)

12893 INSTRUMENTATION FOR HIGH ENERGY COSMIC RAY PHYSICS. Wolfendale, A. W. (Univ. of Durham, Eng.). pp 356-361 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

A short review of instrumentation of high-energy cosmic ray physics is presented. Topics include methods for particle location, magnetic spectrographs, emulsion chambers, ionization measurements, and particle density determination in extensive air showers. (42 references) (WHK)

12894 RECENT APPLICATIONS OF NaI(Tl) TOTAL ABSORPTION COUNTERS. Beron, B. L.; Crawford, J F.; Ford, R. L.; Hofstadter, R.; Hughes, E. B.; Kose, R.; LeCoultre, P.; Martin, T. W.; O'Neill, H O.; Rand, R. E.; Schilling, R. F.; Simpson, J. W.; Wedemeyer R. (Stanford Univ., CA). pp 362-370 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

Recent applications of NaI(Tl) total absorption counters in high-energy physics experiments are discussed. Their use for measuring the mass spectrum of the π^0 peak and for measuring inclusive cross sections in $\pi^+ + p \rightarrow \pi^0 + X$ interactions are discussed. Also, their use at SPEAR in colliding e^+e^- beams for cross section and beam luminosity measurements is briefly described. (WHK)

12895 CHERENKOV DETECTORS. Meunier, R. (CERN, Geneva). pp 371-390 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

A status report on Cherenkov detectors for use in high-energy physics is presented, together with design formulas. Comparisons can be made between the different types of detectors. Mention is made of the special problems associated with the multihundred GeV range of energy of the new accelerators, which require an improvement in Cherenkov detectors by at least an order of magnitude. (auth)

12896 LARGE COVERAGE COUNTER SYSTEM OF THE TOTAL p−p CROSS-SECTION EXPERIMENT AT THE ISR. Amendolia, R. (Univ., Pisa, Italy); Bechini, A.; Bellettini, G. pp 391-396 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

A description of the apparatus fabricated for the measurement of the proton−proton total cross-section at the ISR is given. The apparatus consists of ~400 scintillation counters covering ≈ 90% of the total solid angle. The counters are used for the measurement of the beam−beam interaction rate and for a determination of particle scattering angles and multiplicities. The stability and efficiency of this large scintillator array is checked with an extensive system of light diodes whose operation is controlled by computer. (auth)

12897 COMMENTS ON THE SOLENOID VERTEX SPECTROMETER. Luste, G. J. (Univ. of Toronto). pp 405-409 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

Some of the properties of a large solenoidal magnet as a vertex detector in a multiparticle spectrometer are discussed. (auth)

12898 LARGE HIGH ENERGY HIGH RESOLUTION NEUTRON HODOSCOPE. Aubert, J. J. (Institut de Physique Nucleaire, Orsay, France); Broll, C.; Coignet, G.; Favier, J.; Massonnet, L.; Smith, D. B.; Vivargent, M.; Dibon, H. pp 410-414 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

A high energy neutron counter hodoscope which consists of a carbon converter followed by two large (useful area 120 × 124 cm^2) multiwire proportional chambers with two planes of wires each is described. The results of a calibration in a neutron beam at different energies are presented. The points of neutron impact with the converter are reconstructed in space with a total efficiency of 5.5% ± 0.4% at 24 GeV/c (roughly constant above 8 GeV/c) and an accuracy of the order of half a centimeter (F.W.H.M.). (auth)

12899 LEAD−GLASS CHERENKOV DETECTOR FOR ELECTRONS AND PHOTONS. Beale, J. S. (CERN, Geneva); Buesser, F. W.; Camilleri, L.; Di Lella, L.; Gladding, G.; Placci, A.; Pope, B. G.; Smith, A. M.; Smith, B.; Yoh, J. K.; Zavattini, E.; Blumenfeld, B. J.; Lederman, L. M.; Cool, R. L.; Litt, L.; Segler, S. L. pp 415-421 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

An apparatus for the detection of high-energy electrons and photons is described. Lead-glass Cherenkov counters measure the energies, and charged particle tracks are reconstructed using an array of wire spark chambers. The mode of operation, calibration, and stability of the system are described, and details are given of the ability to discriminate electrons from hadrons. (auth)

12900 CALIBRATION AND PERFORMANCE OF A LARGE MODULAR NEUTRON DETECTOR USED IN AN ON-LINE ELECTROPRODUCTION EXPERIMENT. Betti, G. (Univ., Pisa, Italy); Del Guerra, A.; Giazotto, A.; Giorgi, M. A.; Stefanini, A.; Botterill, D. R.; Braben, D. W.; Clarke, D.; Norton, P. pp 422-429 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

The successful application of a large aperture modular neutron detector, consisting of 145 plastic scintillator elements, operating in a high intensity background environment is reported. A description of the on-line data acquisition and monitoring system is also presented. The threshold on each counter was maintained within ±1 dB and the timing was monitored to ±300 psec, using a multiplexed light diode system under computer control. The efficiency and spatial resolution measurements in the neutron kinetic energy range 15 to 120 MeV are reported and compared with Monte Carlo predictions. (auth)

12901 USE OF CHERENKOV LIGHT IN LIQUID HYDROGEN TARGETS. Sergiampietri, F. (INFN, Pisa, Italy). pp 430-438 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

Cherenkov light produced in liquid hydrogen targets can be used as a trigger in reactions with charged incident particles and only neutral products (or the opposite) for localizing the interaction point along the beam line, and also in reactions with neutral incident particles and at least one charged fast product. From the experimental results on the reaction $\pi p \rightarrow m^0 n$, at 3.8 and 12 GeV/c, with a 40 cm long H_2 target the accuracy in the interaction point localization was found to be ±3 cm, almost uniformly along all the target. (auth)

12902 RELATIVISTIC PARTICLE IDENTIFICATION BY QUASI PERIODIC SCATTERING RADIATION IN CRYSTALS. Brautti, G. (Univ., Bari, Italy). pp 439-440 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

When a highly relativistic massive particle undergoes multiple scattering by an atomic row in a crystal, a characteristic radiation can be emitted whose energy is simply related to the ratio of the particle energy to the rest mass. This effect can be also explained by classical methods, being quite distinct from coherent bremsstrahlung. The use of this effect in relativistic particle identification is discussed especially efficiency, acceptance, and resolving power. (auth)

12903 DEVELOPMENT OF PARTICLE DETECTORS USING SUPERHEATED SUPERCONDUCTING COLLOIDS. Drukier, A. K. (Univ. of Copenhagen); Valette, C.; Waysand, G. pp 441 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

A charged particle passing through a superconducting colloid in the metastable, superheated state leads to a measurable change of the inductance which can be used to build detectors of charged particles. Developments are briefly reviewed. (WHK)

12904 TRANSITION RADIATION X-RAY YIELDS AND SPECTRA FROM ELECTRONS OF 1.3 TO 15 GeV/c. Hawaii-Maryland-Oxford Collaboration. pp 442-444 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

Transition radiation from electrons of 1.3, 3.0, 6, 9, 12, and 15 GeV/c momentum has been detected using noble-gas (argon, krypton, or xenon) multiwire proportional chamber (MWPC) detectors. Radiator-detector arrays of "sandwich" type or "magnetic separation" type were used. TR x-ray spectra and total yields were measured and compared with theoretical predictions. (auth)

12905 LARGE SCALE 3-DIMENSIONAL COINCIDENCE MATRIX SYSTEM USED AT THE OMEGA SPECTROMETER AT CERN. Hartung, R. W. (Univ., Freiburg i B.); Runge, K.; Weber, H. C.; Muller, A. pp 448-450 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

A circuit is described which allows selection, by inserting diode pins in a plug board, of double or triple coincidences between two 33 cell hodoscope planes and an 8 cell Cherenkov hodoscope. (auth)

12906 UTAH COSMIC RAY DETECTOR: OPERATING EXPERIENCE AND FUTURE OUTLOOK. Keuffel, J. W. (Univ. of Utah, Salt Lake City). pp 451-453 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

Operating experience over several years with the Utah cosmic ray detector, a large-scale array of cylindrical spark counters, has been favorable with respect to stability and accuracy of track location and especially with regard to automatic digitized track recognition. Some advantages for accelerator applications, especially the freedom from multispark ambiguities of crossed wire chambers, are pointed out. Techniques are discussed whereby the detector, using a mountain as a muon range analyzer, can be used to study hadronic collisions in the 10^{13} to 10^{16} eV range. (auth)

12907 NEW PRECISION METHOD FOR PERFORMING CARBON POLYETHYLENE SUBTRACTION IN HIGH ENERGY SCATTERING EXPERIMENTS. Lee-Franzini, J. (State Univ. of New York, Stony Brook); McCarthy, R.; Schamberger, R. D.; Franzini, P.; Childress, S. pp 454-456 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

In an experiment to study inelastic proton–proton scattering by detecting slow recoils, deuteron and triton production from proton–carbon interactions was observed. Since deuterons and tritons are detected simultaneously with the elastic events, a method using telescope counters was used to obtain the product (effective beam intensity) × (number of carbon nuclei) in carbon and polyethylene. Results are presented. (WHK)

12908 HADRON ENERGY MEASUREMENT IN A STOPPING PION CALORIMETER. Thompson, J. A. (Univ. of Utah, Salt Lake City); Jones, W. V. pp 457-459 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

The energy of a hadron can be estimated from a knowledge of the stopping charged pions produced in a nuclear-electromagnetic cascade. Monte Carlo results for the slow pions are presented and discussed for primary hadron energies from 3 to 3000 GeV. The number of charged pions which stop in an absorber increases logarithmically with the primary energy of the hadron initiating the cascade. The delayed electrons from the $\pi \rightarrow \mu \rightarrow e$ decay chain distinguish between a cascade with a nuclear component and a purely electromagnetic shower. Since the largest fraction of the cascade energy is fed into the electromagnetic component via the production and immediate decay of π^0s, the number of stopping pion decays gives only a rough estimate of the primary hadron energy; normal standard deviations range from 66% at 3 GeV to 30% at 3000 GeV. Therefore ionization spectrometer measurements are necessary if a cascade energy measurement of high statistical precision is required. This technique has been successfully used in a cosmic ray experiment studying inelastic muon interactions. (auth)

12909 TELEVISION CAMERAS IN HIGH ENERGY PHYSICS EXPERIMENTS. Garvey, J. (Univ. of Birmingham, Eng.). pp 463-472 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

In data collection from optical detectors in high energy physics experiments, television cameras eliminate the necessity of film and offer the possibility of obtaining a digitized record of an event directly. Moreover the cameras can be programmed to read out only selected regions of the field of view, thus reducing the stored data for an event to a minimum. A brief description of operating characteristics of the available television camera tubes is given; and some present applications of television camera systems are discussed including the Omega spectrometer at CERN, streamer spark chambers, optical spark chambers in the eta experiment at RHEL, and rapid cycling bubble chambers. (WHK)

12910 AUTOMATIC ANALYSIS OF BUBBLE CHAMBER PICTURES. Masetti, M. (CNAF, Bologna). pp 473-476 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

The performances, capabilities, and problems with HPD's, CRT devices, and spiral readers for automatic analysis of bubble chamber films are briefly discussed. (WHK)

12911 DEVELOPMENTS IN DATA COLLECTION AND PROCESSING FOR ELECTRONIC EXPERIMENTS. Zanella, P. (CERN, Geneva). pp 477-479 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

Developments being carried out at CERN which represent the new trends in data acquisition and processing are discussed.

Topics include data acquisition and multi-user environments, high capacity data storage, and fast data processing. (WHK)

12912 INTEGRATED COMPUTER AND DATA-PROCESSING NETWORKS. Zacharov, B. (Daresbury Nuclear Physics Lab., Daresbury, Eng.). pp 480-484 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

It is argued that the best solution to meet the data-acquisition and other computational requirements of high-energy physics laboratories is to integrate local computing facilities into interconnected networks. The discussion is made by reference to the DNPL computer network, whose principal features and facilities are outlined. The problem of extension and expansion of network systems is considered, and it is concluded that there should be no principal difficulties in scaling the Daresbury network by a factor of at least five. (auth)

12913 2500 WIRE MULTIWIRE PROPORTIONAL CHAMBER SYSTEM AND CAMAC INTERFACE TO STUDY K^+ DECAY IN FLIGHT. Haggerty, H.; Handler, R.; March, R.; Martin, P.; Pondrom, L.; Wilke, W. (Univ. of Wisconsin, Madison). pp 485-486 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

A 2500 wire MWPC system and a magnet have been combined into a spectrometer to measure space angles of K^+ decay in flight and momenta of the charged secondaries. Relevant operating parameters and measurement errors are given. (auth)

12914 TELEVISION CAMERA SYSTEM FOR DATA ACQUISITION ON THE OMEGA SPECTROMETER. Garvey, J. (Univ. of Birmingham, Eng.); Amato, G.; Gildemeister, O.; Briandet, P.; Huffer, E.; Appleby, L.; Barnard, R.; Lipman, N.; Morris, D.; Owen, D.; White, D.; Wilde, P.; Lister, J. pp 487-496 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

The characteristics of the Omega spectrometer and the characteristics of the set of television cameras used to digitize the positions of the sparks in the spark chambers are presented. The proposal to use television cameras instead of film cameras was made in December 1970 and accepted in Autumn 1971. Two cameras were installed on Omega in June 1972 and the complete set of six in July 1972. These were set up and became operational and in October one million events were written on tape and have been subsequently analyzed. (WHK)

12915 HARDWARE PROCESSORS FOR PATTERN RECOGNITION TASKS IN WIRE CHAMBER DATA. Hansroul, M.; Verkerk, C.; Zanella, P. (CERN, Geneva). pp 497-499 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

A method for the recognition of curved tracks and its implementation in digital hardware is presented. Similar hardware processors can be used for point-finding in multi-plane multiwire chambers. A comparison is made of the execution speed of special purpose hardware processors and Fortran routines running on large scale general purpose computers. Polynomial evaluators which are mentioned can be of interest for event selection. (auth)

12916 TRIGGER AND CONTROL SYSTEM FOR A 50K-WIRE PROPORTIONAL CHAMBER DETECTOR. Bell, W.; Brandt, A.; Fluegge, G.; Minten, A.; Sauli, F.; Schubert, K. R.; Wilmsen, W. (CERN, Geneva). pp 500-504 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

A trigger and control system for a 50K-wire proportional chamber detector is described. The detector will be installed in a magnetic spectrometer at the CERN ISR. The proportional chambers provide the essential parts of the trigger. From a total event rate of 10^6/sec, the trigger has to suppress the background and to reduce the data acquisition rate to some 10^2/sec. The selection is done in two steps: (1) a FOR decision based on Fast OR signals from chamber planes, and (2) a MOR decision based on the Memory OR of groups of 32 wires, corresponding to 64 mm geometrical resolution. (auth)

12917 DESIGN PHILOSOPHY FOR A HARDWARE PRELIMINARY DATA REDUCTION IN A HIGH ENERGY SCATTERING EXPERIMENT USING SOLID STATE DETECTORS. Franzini, P. (Columbia Univ., New York); Childress, S.; Lee-Franzini, J.; McCarthy, R.; Schamberger, R. D. pp 505-506 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

The experiment consisted of a series of telescopes each formed of two solid state detectors. All telescopes look at a target bombarded with the 200 to 400 GeV external proton beam and they are used to detect recoils from such a target. In addition, the energy of the recoils is to be determined by measuring the charge signal output by the detector to one part in 2^{12}. An event thus consists of two counters in a telescope giving a simultaneous signal. It is however of interest to know how many times another counter in the array was also crossed by a particle. In other words, all counters are to be examined, whenever any telescope is active. A severe constraint is the extremely low duty cycle and high instantaneous even rate. To this end, each counter signal is fed to a discriminator and an analog channel terminating in a sample and hold amplifier. A master trigger is formed corresponding to a coincidence in any telescope. Upon receipt of such trigger, all discriminators are entered into registers and all sample and hold amplifiers are switched to sample mode and back to hold mode. All these operations are performed in approximately 400 nsec, this time being necessary for the S and H amplifier to settle to the required accuracy. About 100 nsec after receipt of a trigger the data reduction hardware begins to analyze the data. A schematic of the system is shown. (WHK)

12918 BUBBLE AND SPARK CHAMBER DATA ANALYSIS AT C.N.A.F.: ACTUAL STATUS AND FUTURE DEVELOPMENT. Bacilieri, P.; Castelvetri, A.; Errani, M.; Fonti, L.; Shiselli, A.; Guglieri, A.; Luvisetto, M. L.; Masetti, M.; Matteuzzi, P.; Pazzi, P.; Sangiorgio, L.; Simoni, L.; Sini, G. P.; Ugolini, E.; Venturi, D.; Zanotti, U. pp 519-523 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

The automatic HPD devices on-line to the IBM 360/44 for automatic analysis of bubble and spark chamber data are described. (WHK)

12919 PEPR II SYSTEM AT OXFORD AND PADOVA. Bettini, A. (Univ., Padua); Centro, S.; De Giorgi, M.; Pascoli, D.; Peruzzo, L.; Pinori, C.; Pozzan, M. R.; Brooks, C. B.; Payne, J. pp 524-529 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

A pair of twin PEPR II systems have been designed and built in collaboration between Padova and Oxford. The system that is described has some relevant features that make it different from other PEPR's. The track signals method of analysis and the capability of controlling from software almost every function of PEPR are two of the main characteristics. The new signal processor (SPARE), which has been completely digitized, provides full pedestal removal and optional averaging to improve S/N. The digital controller is modular, with unibus structure and accommodates up to 32 16 bit registers, each accessible by computer and through external connectors. (auth)

12920 PRELIMINARY TESTS ON A SPIRAL READER-TYPE AUTOMATIC MEASURING SYSTEM. Laakso, I. (INFN, Rome). pp 530-533 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

A working model of a measuring system for bubble chamber films has been constructed. The scan in spiral movement is obtained by mechanical means. Results are given on tests made on the feasibility of the scanner. All parts of the system have been successfully tested. First static digitizings of the radial coordinate using a precision test grid were obtained. (auth)

12921 MEASURING PROJECTOR WITH ANALOGUE SERVO SYSTEM. Mehlhop, W.; Piccioni, O.; Scipione, D.; Allen, P.;

Bowles, P.; Garland, R.; Kobrak, H.; Marraffino, J.; Murty, S. pp 534 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

A measuring projector with a servomechanism that enhances the efficiency of the operator by allowing him to perform the measurements as if he were following a track with the point of a pencil is described. (auth)

12922 AUTOMATIC SCANNING AND MEASURING MACHINE USING A T. V. DEVICE. Heughebaert, J. (Interuniversity Inst. for High Energies, Brussels). pp 535-538 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

The application of cylindrical lenses in automatic detection of bubble chamber tracks is presented. Such a detector performs an optical filtering of the information contained in bubble chamber pictures and defines the mean of the coordinates of a succession of bubbles aligned along track elements. The general structure of a measuring machine under construction in Brussels and using this detector in conjugation with a T. V. camera is briefly described. (auth)

12923 MIR: SCANNING AND MEASUREMENT TABLES FOR LARGE BUBBLE CHAMBERS. Baton, J. P. (CEN de Saclay, Gif-sur-Yvette, France); Blumenfeld, H.; Kochowski, C.; Miche, R.; Pichard, B.; Quidort, J.; Sauget, B.; Sellier, J. C. (CEN de Saclay, Gif-sur-Yvette, France). pp 539-544 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

The MIR tables described are scanning and measuring tables, built for the projection of film from the big European bubble chambers, Mirabelle and BEBC. The design of the tables stresses ease of handling, good optical quality and high precision. The tables are linked to a PDP 15 computer, both for the scanning and measuring mode. The tables have been in operation for one year. The design and performance of the tables are discussed. (auth)

12924 INITIAL PERFORMANCE OF MOLLY, AN AUTOMATIC SCANNING AND MEASURING SYSTEM. Slater, W. E. (Univ. of California, Los Angeles). pp 545-550 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

MOLLY is a second generation, single view film measuring system based on the POLLY type slice scan. This system is capable of resolving parallel tracks that are separated by as little as 40 microns, center-to-center. Stability is excellent; measured drifts are of the order of 2 microns per hour. Preliminary work indicates that adequate distortion correction can be made with a third order polynomial multiplied by an ideal pincushion factor. A track finding and following program has been developed that works on both streamer and bubble chamber film provided only that a table of parameters is properly chosen and that CRT spot diameter is roughly equal to the track width. (auth)

12925 RECONSTRUCTION OF EVENTS IN MIRABELLE. Blumenfeld, H.; Derre, J.; De Beer, M.; Granet, P.; Laugier, J. P.; Loret, M.; Prevost, J. (CEN de Saclay, Gif-sur-Yvette, France). pp 551-553 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

MIRABELLE has been in operation at the IHEP Accelerator at Serpukhov since the fall of 1971. Based on the measurements of events from the first physics run pp at 69 GeV/c, results are presented on the measurements of fiducial marks, vertex reconstruction, track reconstruction, invariant masses and the treatment of events of all multiplicities using the HYDRA GEOMETRY program. (auth)

12926 DATA STORAGE SYSTEM FOR BUBBLE CHAMBER EXPERIMENTS. de Groot, J. G. H.; Holthuizen, D. J.; de Jonge, H.; Tenner, A. G. (Univ. of Amsterdam). pp 554-555 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

In bubble chamber data evaluation, various steps have to be taken in scanning and measuring and a chain of programs has to be applied before the final results are obtained. In the described system different experiments may be carried out at the same time, making use of either hand measurements (ENETRA) or HPD automatic measurements. All measuring equipment is treated online by a CDC 6400, that also is in charge of the subsequent computations (HYDRA chain). A system has been developed by which the initial and intermediate data of all programs are stored on a magnetic disk (841 or 844) in such a way, that each program has access to its input data without human intervention and makes available the output data to the following program in the chain. Stored data may be scanning lists, hand measurement results, HPD output, remeasurement instructions for failed HPD events, HYDRA kinematics results etc. (auth)

12927 COMBINED HARDWARE- AND SOFTWARE SYSTEM FOR A ZERO GUIDANCE MEASUREMENT OF BUBBLE CHAMBER PHOTOGRAPHS. Hertzberger, L. O.; Harting, D.; Holthuizen, D. J.; van Dam, P. H. A. pp 556-562 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

A combined hardware- and software system, to do pattern recognition on line using digitizings (pairs of coordinates) from an HPD flying spot scanner is described. To be able to process the digitizings within 7 μs maximum time (and an average of 3.4 μs) the hardware was designed with high speed TTL. The system (HPD and special purpose processor) is controlled by a peripheral processor of a CDC 6400 computer. Software is developed not only to control the processor, but also to implement it in a measuring chain that will be used to measure the primary interactions of a 7.3 GeV/c $\bar{p}p$ experiment in a zero guidance mode. The method used, and the preliminary results are reported. In particular the features of the hardware processor "ZGE" (Zero Guidance Electronics) are described in some detail. (auth)

12928 DEVELOPMENTS IN PLASTIC SCINTILLATORS. Zichichi, A. (CERN, Geneva). pp 565-585 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

Developments in large-dimension plastic scintillators that are discussed include electromagnetic shower detectors with high rejection power against hadrons, high-resolution neutron detectors, and long attenuation length counters for new particle searches at the ISR. Developments in standard dimension plastic scintillators include accurate dE/dx measurements which prove there is a relativistic rise in energy loss in plastic scintillators and the development of a powerful beam optics scintillation detector with high space and time resolution. Experimental arrangements and performance data are presented graphically. (WHK)

12929 PROGRESS IN PMT FOR HIGH ENERGY PHYSICS INSTRUMENTATION. Pietri, G. (Laboratoires d'Electronique et de Physique Appliquee, Limeil-Brevannes, France). pp 586-591 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

A brief review on developments on photomultiplier tubes (PMT) for use in high energy physics, particularly for use with Cherenkov and scintillation counters, is given. Topics include statistical characteristics of PMT, new dynode materials, improvement of the multiplier statistics, new multiplier designs, novelties in the field of photocathodes, and PMT with negative electron affinity (NEA) cathodes. (WHK)

12930 IMPACT OF RECENT INTEGRATED CIRCUIT DEVELOPMENTS ON INSTRUMENTATION FOR HIGH ENERGY PHYSICS. Herbst, L. J. (Teesside Polytechnic, Middlesborough, Eng.). pp 592-604 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

Electronics instrumentation for high energy physics is being

implemented increasingly with integrated circuits, especially digital ICs. The primary circuit requirements of such instrumentation are outlined. Currently available linear and digital ICs most suitable for use in this field are reviewed, with commercial considerations determining integrated circuit developments borne in mind throughout. The specifications for linear ICs are discussed with special reference to multiwire proportional chambers, which require linear ICs for detection prior to data processing. Two main factors determine the choice of digital ICs. The first of these, common to most applications involving data processing, is to decide on the most suitable elements for the desired volume of data handling at the required speed. A critical comparison is made of the bipolar and MOS IC facilities available and being developed. The other major consideration, always important in high energy physics, is ultra fast operation at nanosecond speeds. Some recent developments in ultra high speed discrete and integrated circuit techniques are reviewed. It is predicted that operation at rates up to between 2 and 3 GHz should be possible within the next few years using silicon bipolar transistors. Suggested logic manipulations in instrumentation, illustrated with specific examples, to realize the fastest processing with minimum loss in high energy physics experiments are included. (auth)

12931 USING HIGH SPEED DIGITAL INTEGRATED CIRCUITS FOR NUCLEAR INSTRUMENTATION. Althaus, R. F.; Lee, K. L.; Kirsten, F. A.; Wagner, L. J. (Lawrence Berkeley Lab., CA). pp 609-615 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

Two modular packaging schemes using MECL III integrated circuits have been developed at the Lawrence Berkeley Laboratory. The first described, called the FLOGIC System, achieves high packaging density by means of logic cards that are interconnected in a custom design unique to each experiment. The FLOGIC System is most suitably used where many channels of instrumentation are required and the configuration of these channels, once established, is not subject to frequent unprescribed change. The second scheme uses the NIM Standard hardware. This scheme offers the convenience and versatility of standardized hardware and signal levels. Circuit diagrams and performance data are given. (WHK)

12932 SOME REMARKS ON ELECTRONICS FOR DRIFT CHAMBERS. Verweij, H. (CERN, Geneva). pp 616-621 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

A brief outline of the required functions is given. Analogue and digital time measuring methods are compared. Amplifiers and current division circuits are discussed. A method for storage of analogue information, the analogue shift register, is proposed. Functional block diagrams and more detailed information is given on complete systems, which are at present being developed at CERN. They allow the measurement of two orthogonal coordinates, one by the drift time, the other by the current division. (auth)

12933 ELECTRONICS FOR A SYSTEM OF VERY LARGE PROPORTIONAL DRIFT CHAMBERS WITH SPATIAL AND TIME RESOLUTIONS. Cheng, D. C.; Kozanecki, W. A.; Picciotti, R. L.; Rubbia, C.; Sulak, L. R.; Weedon, H. J.; Whittaker, J. (Harvard Univ., Cambridge, MA). pp 622-626 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

The general organization of the electronic readout for a system of very large (16 m^2) drift chambers, and a novel device, the "time expander", are discussed. (auth)

12934 ELECTRONICS FOR SOLID STATE DETECTORS IN HIGH ENERGY PHYSICS EXPERIMENT. Franzini, P.; Schamberger, R. D. (Columbia Univ., New York). pp 627-630 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

The electronics required for using silicon solid state detectors is described. This consists of charge sensitive preamplifiers, discriminators with special features, active filters and sample and hold amplifiers. The reasons for developing anew such devices were many, notably cost and non-existence of some items with characteristics suitable to the use of silicon detectors at a very low duty cycle machine. The schematic of each circuit is presented with a brief description. (auth)

12935 SPECTROMETERS FOR HIGH ENERGY PHYSICS. Michelini, A. (CERN, Geneva). pp 633-654 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

The spectrometers now in operation or being constructed at (1) proton accelerators from a few GeV up to 70 GeV, (2) storage rings of all kinds, and (3) present NAL and future CERN-SPS are reviewed. The wire spark chambers, plate spark chambers, and multiwire proportional chambers used at proton accelerators up to 70 GeV are discussed; the 4π geometry spectrometers used at storage rings which mostly include solenoids and cylindrical spark chambers and multiwire proportional chambers are reviewed; and the focusing spectrometers and general purpose multiparticle spectrometers at NAL and CERN-SPS are discussed. Design, performance, and utilization parameters are tabulated for various spectrometers at high energy physics facilities. (29 references) (WHK)

12936 ARGONNE EFFECTIVE MASS SPECTROMETER. Ayres, D. S. (Argonne National Lab., IL). pp 665-668 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

The heart of this facility is a large aperture dipole magnet surrounded by magnetostrictive readout spark chambers with an online EMR-6050 computer. It is supplied with unseparated positive or negative beams of up to 6 GeV/c from the Zero Gradient Synchrotron (ZGS). The spectrometer is distinguished by good resolution (effective mass resolution of ± 3 MeV for K^{0}s) and a high data rate capability (up to 45 events per beam pulse). The hardware is quite flexible, allowing target geometry and triggering schemes to be changed easily. A set of four cylindrical spark chambers around a hydrogen target was recently installed and is performing well. The facility has been extremely productive, with data taking for seven experiments being completed in 13 months of running. Future experiments include studies of pp interactions with a polarized proton beam. (auth)

12937 CERN OMEGA SPECTROMETER. Gildemeister, O. (CERN, Geneva). pp 669-671 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

A brief general description of the CERN OMEGA spectrometer is given. The basic features of the magnet, the detectors, and the experimental trigger arrangements are mentioned. (auth)

12938 BNL MULTI-PARTICLE SPECTROMETER. Platner, E. D. (Brookhaven National Lab., Upton, NY); Foley, K. J.; Kramer, M. A.; Lowe, W. A.; Miller, W. J.; Morris, T. W.; Ozaki, S.; Saulys, A. C.; Willen, E. H.; Lindenbaum, S. J. pp 672-678 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

Work is in progress at Brookhaven National Laboratory to build a large multi-particle spectrometer (MPS). This spectrometer features a large field volume C-magnet (6 ft. wide by 15 ft. long pole and 4 ft. high gap) which is equipped with many low mass wire spark chambers with digitized readout and several multiwire proportional chambers located inside the magnet gap as the basic detector elements. A liquid hydrogen or deuterium target of several feet in length can be placed in the magnet with various target area detector configurations around it, thus giving close to 4π solid angle detection. The great length of the magnetic field volume allows considerable decay space, with analyzing power, for long-lived reaction products. Details of the MPS magnet, the detector layout, and two target assembly areas are described. Four approved experiments for the first round of the program are briefly described. (WHK)

12939 USE OF TOROIDAL MAGNETIC FIELDS FOR LARGE VOLUME MAGNETIC SPECTROMETERS. Spillantini, P. (CNEN, Frascati, Italy). pp 679-687 of 1973 International Conference on

Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

The advantage of collecting reaction products in the "natural reference frame" (i.e., the polar coordinate system with the beam as polar axis) of the reaction is connected mainly to the independence of the two angular coordinates θ and φ. The only type of magnetic field which gives this independence for a large volume is a "toroidal magnetic field": the particles are deflected only in θ, while φ is not disturbed. The simplest way of producing the field is to pass a current I along the polar axis, giving $B(r) \propto I/r$ (r = distance from the polar axis). A spectrometer based on such a field offers most remarkable advantages both for the magnet and for its apparatus. From evaluations carried out for large volume detectors for experiments both with storage rings or with very high energy beams, it results that spectrometers with toroidal magnetic fields can really be constructed using standard techniques. They are more convenient than conventional spectrometers when a resolution of the order of 1% is required for particles with a momentum of less than 100 GeV emitted at $\theta \gtrsim 0.5°$. For momentum measurement outside this region, cryogenic or superconducting techniques lead to encouraging prospects. (auth)

12940 INVARIANT MASS RESOLUTION OF A FILMLESS SPARK CHAMBER SPECTROMETER. Birulev, V. K.; Golutvin, I. A.; Grigalashvili, T. S. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 688-693 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

It is shown that the spectrometer invariant mass resolution is stable in time and dependent on the momentum of decaying kaons. The standard deviation of the mass peak for various momenta is described by the formula $\theta_{m\pi\pi} = 2.06$ (MeV) + 0.06 · P (MeV/GeV/c). It is also shown that the mass peak shape can be reproduced by the Monte-Carlo method taking into account experimental errors and multiple scattering in the matter along the particle trajectories. The experiments on the investigation of the neutral kaon regeneration on hydrogen, performed at the Serpukhov accelerator, are described. (auth)

12941 TRIGGER OF A FILMLESS SPARK CHAMBER SPECTROMETER IN NEUTRAL KAON EXPERIMENTS. Birulev, V. K.; Fadeev, N. G.; Golutvin, I. A.; Grigalashvili, T. S.; Gus'kov, B. N.; Ivanchenko, I. M.; Krivokhizhin, V. G.; Kukhtin, V. V.; Lichachev, M. F.; Salomatin, Yu. I.; Savin, I. A.; Senner, A. E.; Smolin, D. A.; Takhtamyshev, G. G.; Todorov, P.; Vovenko, A. S. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 694-700 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

The influence of background conditions on the trigger efficiency of the setup that detects neutral kaon decays has been investigated. An optimal trigger is found providing a high percentage of useful events detected in experiments with hydrogen, deuterium, and carbon regenerators. (auth)

12942 ANGULAR RESOLUTION OF A FILMLESS SPARK CHAMBER SPECTROMETER-DETECTOR OF NEUTRAL KAON DECAYS. Birulev, V. K.; Golutvin, I. A.; Grigalashvili, T. S. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 701-706 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

It is shown that the angular resolution of the spectrometer depends on the momentum of decaying kaons. The main contributions to the resolution are made by multiple scattering and coordinate accuracy in the spark chambers. (auth)

12943 UNIVERSAL SUPERTELESCOPE (UST) WITH SCINTILLATORS FOR THE REGISTRATION OF COSMIC RAYS OF μ-MESON INTENSITY. Alaniya, M. V.; Shoniya, O. K. (Inst. of Geophysics, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz, SSR; 72: No. 2, 329-332(Nov 1973). (In Russian).

The described universal supertelescope consists of three lines of scintillation detectors operating as two separable telescopes of double coincidence. The method for the computation of the scintillator monitor is given on the basis of the parameters of the scintillator, the multiplier phototube, and the amplifier. The scintillator thickness is longer than the noise particles path, which is taken into account. (auth)

12944 HIGHLY LINEAR FAST SAMPLING SYSTEM FOR NON-RECURRING PULSES. Shrum, E. V.; Stephens, W. A.; Ziock, K. O. H. (Univ. of Virginia, Charlottesville). Nucl. Instrum. Methods; 114: No. 1, 87-91(1974).

A fast sampling system for on-line use was built that sampled and digitized non-recurring pulses 16 times at intervals of 18.5 ns with an integral non-linearity of less than 0.1%. The system was used to measure the height of a pulse that was riding on another pulse of varying amplitude (i.e., to measure the height of the muon pulse independently of the pion pulse in the $\pi^+ \rightarrow \mu^+ + \nu_\mu$ decay in a Ge(Li) detector.) (auth)

12945 UNIVERSAL DECISION MAKING DEVICE FOR ON-LINE DATA SELECTION IN SCATTERING EXPERIMENTS. Guzik, Z.; Basiladze, S. G. (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Instrum. Methods; 114: No. 1, 83-86(1974).

A universal digital unit, intended for arithmetic data selection for scattering experiments, using multiple proportional wire chambers is described. The unit is made using CAMAC standard with fully ECL integrated circuits. The circuit is dc coupled throughout. The maximum decision time is about 100 ns. (auth)

12946 SEQUENTIAL ANALYSIS AS A MEANS FOR SEPARATION OF GREY AND RELATIVISTIC TRACKS IN NUCLEAR EMULSIONS. Friedlander, E. M.; Haiduc, M. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 18: No. 7, 821-824(1973).

A new method is suggested for separating gray and relativistic tracks in nuclear emulsions, which makes use of sequential analysis based on the criterion of probability ratios and which reduces the effort necessary for such a classification to about 50% of that required in the classical approach. (auth)

Radiometric Instruments

12947 GAMMA GAUGE FOR THE CONTROL OF INTERZONE LAYER IN AN EXTRACTION TOWER. Elias, E.; Segal, Y.; Notea, A. (Technion–Israel Inst. of Tech., Haifa). Nucl. Technol.; 21: No. 1, 57-66(Jan 1974).

A gamma-ray transmission gauge was applied for the measurement of the interzone-layer parameters in an extraction tower. The "resolving power" function of the gauge was used to obtain the optimum design parameters, such as gamma-ray energy, source-to-detector distance, and gauge location on the separation tower. Results from a prototype gauge operated on a furfural extraction tower in the lubrication oil industry are presented and discussed. The mathematical model described offers guidelines for analyzing similar gauging problems. (auth)

12948 GAMMA SCATTERING IN MARINE SEDIMENTS. Roney, J. R. Kingston, RI; Univ. of Rhode Island (1973). 215p. University Microfilms Order No. 73-31,020.

Thesis (Ph. D.).

The principal scope of the investigation was the examination of Compton scattering and photoelectric absorption in the near field, close to an isotopic source of gamma radiation. The dependence of the processes on the density of the material surrounding the source and on chemical composition was studied by analysis and experimentation. A laboratory experimental program was conducted to study the response of backscatter systems in cylindrical geometry, representing axi-symmetric backscatter probes. A Monte Carlo computer simulation was developed to aid in interpreting the experimental results and in establishing the principles developed. The Monte Carlo simulation revealed that single scattering of photons into the detector is the dominant mode when the detector is closely spaced from the source. Two dimensional scattering experiments with collimated source and detector conformed to a single scatter model in which photons reached the detector by two paths from source to the detector, within a limiting separation distance as predicted by the computer simulation. Three dimensional experiments in cylindrical geometry with close spaced source and detector conformed to a more developed single scatter model. Collimation of the source and of the detector showed a response dependent on collimation angles as well as the source to detector spacing. It was further shown that a correspondence exists between this spacing and the collimation angles which acts selectively for singly scattered photons reaching the detector. If the angle is not matched by a geometric association, the response of the system to a change in density departs in a manner such that the count rate is less sensitive to density increases. From the laboratory information developed, a prototype design of a sediment density gage was fabricated and tested. This dual probe which included a transmission and a backscatter system was used to compare the response in identical media. Results indicated that a close spaced, collimated backscatter probe can be designed with accuracy and sensitivity to vertical density differences comparable to a transmission system. (Diss. Abstr. Int., B)

12949 EQUIPMENT FOR STUDYING SOILS. Corossi, J. C.; Chanu, D.; Couchat, P. (to Commissariat a l'Energie Atomique). French Patent 2,144,086. 30 Jun 1971. 10p. (In French).

Equipment for studying soils is presented. It consists of a radiation source, a device for detecting radiation after its absorption or scattering by the soil under investigation, and a probe containing the source and detector. Means are provided for displacing the probe (in particular inside a well) and for measuring and determining the intensity of the radiation detected at various positions of the probe, or, that of a parameter dependent on the intensity. In addition, the equipment is provided with means for recording the results furnished by the measurement part and the parameters associated with each measurement together with means for automatically controlling a cycle, or, a series of cycles of successive measurement-recording operations, each, at least possessing a control over the displacement part (this part displacing the probe through a predetermined distance), and a control over the measurement and recording parts. (FR)

12950 NEUTRON GAMMA LOGGING DETERMINATION OF CARBONATE COLLECTORS POROSITY IN THE EASTERN TURKMENIYA. Kerimov, T. G.; Kotov, P. T. Razved. Geofiz.; No. 55, 161-163(1973). (In Russian).

By comparison of the core porosity k_p with the relative difference parameters of neutron-gamma logging, the possibility of the determination of the k_p of the gas-bearing carbonate collectors of the Saman-Tep deposits from neutron-gamma logging was shown. The coefficient for the calculation of the effect of the gas on the response of the neutron-gamma logging in the porosity determination was obtained. This coefficient is recommended for other deposits of the Eastern Turkmeniya in view of the uniformity of the collector. (tr-auth)

12951 RADIOACTIVE LOGGING DETERMINATION OF POROSITY AND CLAY PROPERTIES OF PRODUCTIVE BEDS. Bal'vas, Yu. P.; Basin, Ya. N.; Kukharenko, N. K.; Tyukaev, Yu. V. Razved. Geofiz.; No. 55, 109-116(1973). (In Russian).

On the basis of experimental investigations on stratified models and in boreholes, the selection of radioactive logging probes, measurement regime, and method for the calibration of the apparatus was justified for terrigenous collector conditions. The method developed for quantitative determinations from radioactive logging data on the porosity and clay properties of the terrigenous collector with the greatest probable value of the porosity being used as a reference stratum is described. The results of the application of the method to basic sites for detailed study of the productive beds are reported. (tr-auth)

12952 DIGITAL RECORDER CHANNEL OF GAMMA-LOGGING RADIOMETER. Davydov, A. V. Geofiz. App.; No. 51, 145-146 (1973). (In Russian).

One of the channels of the Zond-2 radiometer was substituted on the digital recorder channel. Analog signals were converted into digital signals by time quantization. All elements of the channel were completed on the 2TKO41 microcircuit. (tr-auth)

12953 TWO-CHANNEL COMPARATIVE METHOD OF ENERGY SPECTRUM EVALUATION IN MEASUREMENTS USING GAMMA-RAY BACKSCATTERING. Seda, J.; Musilek, L. (Faculty of Nuclear Sciences and Physical Engineering, Prague). Nucl. Instrum. Methods; 114: No. 1, 183-185(1974).

The energy spectrum in a thickness measurement using gamma-ray backscattering depends on the measured thickness only at the lower part. The method of evaluation of the spectrum by comparing its two parts (the lower and the upper one) is presented. The ratio of the output signals in both parts depends on the measured thickness only, but does not depend on the activity of the radiation source. (auth)

12954 DETERMINATION OF THE MEAN SIZE OF SOLID PARTICLES CONTAINED IN A MEDIUM. Carr-Brion, K. G.; Bramwell, S. E. (to National Research Development Corp.). British Patent 1,323,695. 18 Jul 1973. Filed date 2 Oct 1969. 7p.

A method is described for determining the mean size of solid particles of relatively high atomic number contained in a medium, such as a fluid, of relatively low atomic number. The method involves irradiating the material so that appreciable scattering of the radiation occurs. The incident radiation includes at least one component having an energy such that the intensity of the Compton scattering corresponding to this component shows an appreciable dependence on particle size. Measurement is made of the respective intensities of two parts of the scattered radiation of different wavelength, these intensities differing appreciably in respect of their dependences on the size of the particles. The ratio of the intensities gives a measure of the mean size of the particles. Intensity measurements are made using a common detector with analyzing means for resolving the energies of the relevant parts of the scattered radiation. The two parts of the scattered radiation whose intensities are measured may consist respectively of Compton and Rayleigh scattered radiation, the ratio of the respective intensities being dependent on the proportion of solid particles in the medium as well as the mean size of the particles, this proportion either being known or measured separately when an absolute measure of the mean particle size is required. The proportion may be determined using a γ-ray density gauge. On the other hand the two parts of the scattered radiation may both be Compton scattered. The incident radiation may be x-radiation; alternatively a ^{238}Pu source may be used, which emits U-L x radiation. Apparatus for carrying out the method is described. (UK)

Radiation Effects on Instrument Components, Instruments, or Electronic Systems

Refer also to abstract 13234.

12955 (HEDL-TME-73-86) ORGANIC CABLE INSULATION COMPARISON TESTS. Muhlestein, L. D.; Philipp, L. D.; Allen, L. E. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Nov 1973. Contract AT(45-1)-2170. 39p. AT.

Electrical properties, including breakdown pulse noise, insulation resistance, capacitance, characteristic impedance and intrinsic leakage current, were measured for three organic-insulated instrumentation cables as functions of temperature, voltage, and/or gamma radiation exposure. For temperature–voltage regions given by $T \leq 400°F$, $V \leq 2000$ Vdc or $T \leq 600°F$, $V \leq 1000$ Vdc, two of the cables evidenced satisfactory electrical characteristics and experienced only slight radiation damage from a total dose of about 2.5×10^{10} R. For the FFTF, the cable having 100% polyimide insulation could be utilized as backup for the ex-vessel neutron-flux instrumentation system. In addition, this cable may be applicable for ex-vessel use for LMFBR instrumentation. (auth)

12956 (N-71-22365) SILICON-CONTROLLED RECTIFIERS WITH IMPROVED RADIATION RESISTANCE. Final Report. Wentink, R. F. (General Electric Co., Auburn, N. Y. (USA). Semiconductor Products Dept.). 31 Oct 1970. Contract NAS3-11831. 98p. (NASA-CR-72842). NTIS.

A 600 volt, 475 ampere silicon-controlled rectifier (SCR) was designed and optimized to improve the nuclear radiation resistance to exposures of 5×10^{13} nvt and 1 million rad. Theoretical device models were developed to analyze the SCR in a radiation environment and to predict consequent changes in device characteristics. Calculations were performed using numerical techniques to design a theoretically optimized structure characterized by a shallow diffused forward blocking junction, a narrow p-base and a highly sensitive gate using pilot triggering. Fabrication was attempted but difficulties were encountered in producing devices which exhibited the desired blocking voltage. This resulted from nonuniformities in the shallow diffused junction. In order to obtain a reasonable blocking voltage yield, it was necessary to increase the diffusion depth of the forward blocking junction. Since the latter adversely affects the radiation resistance, it was concluded that a definite trade-off exists between radiation resistance and available processing technology required for high current SCRs. (auth)

12957 DEFECT LEVELS IN NEUTRON-IRRADIATED GaAs SCHOTTKY DIODES AND LASER DIODE DEGRADATION. Ludman, J. E. Boston; Northeastern Univ. (1973). 113p. University Microfilms Order No. 73-28,833.

Thesis (Ph. D.).

GaAs Schottky and laser diodes were irradiated with high energy neutrons and the resultant trap and defect structure analyzed. The Schottky diodes were irradiated with a clean high energy neutron beam from a Van de Graaff accelerator, and the laser irradiation was done in a nuclear reactor. The defect structure is shown to consist of energetically discrete trap levels but the levels are found not to operate independently. A new defect model is proposed based on coupled defect levels and is shown to be in good agreement with the observations. On the basis of this model, values for the discrete trap levels are determined. Experimentally, Schottky diodes are cooled to temperatures in the region 78 to 176°K, the back bias is turned off and on again, and the capacitance versus time (capacitance decay) is monitored. These measurements are used to derive the activation energies of the trap levels. Trap levels are found at 175, 220, 325, 380, and 460 millivolts below the conduction band. Several general numerical techniques are developed for the purpose of fitting

experimental data to both the independent-level and coupled-level decay models. (Diss. Abstr. Int., B)

Miscellaneous Instruments

Refer also to abstracts 12997, 13076, 13166, 14809, 14825, 15108, 15111, 15184, and 15196.

12958 (AI-AEC-12808) TRANSIT TIME FLOWMETER-THERMOCOUPLE RESPONSE COMPARITOR. Randall, R. L.; Cassidy, R. B. (Atomics International, Canoga Park, Calif. (USA)). 27 Mar 1969. 9p. Dep. NTIS $3.00.

Techniques and apparatus for comparing and matching the time response of sheathed, grounded junction thermocouples used in the transit time flowmeter development program are described. Applications include quality control of TC fabrication and reduction of potential errors in transit time flow measurement from differences in TC time response. (auth)

12959 (ANL-7996, pp 153-155) CENTRAL REAL-TIME COMPUTER FACILITY. Day, P. P.; Hines, J. J.; Zielen, A. J. Feb 1973.

In chemistry division annual report, July 1971–June 1972.

The central Σ-5 computer facility of the ANL Chemistry Division which provides real-time computer service to support various research efforts is briefly described. A list of experiments being supported by the facility and those planned for the future is given. (TFD)

12960 (BARC-690, pp 155-163) INSTRUMENTATION. 1973.

Developments discussed include a transistorized power supply for the Beckman DU spectrophotometer, a master clock pulse generator, a modular printing unit, a flash photolysis setup, a glove box assembly for a Perkin–Elmer infrared spectrophotometer, and a Faraday balance for measuring the magnetic susceptibilities of actinide compounds. (WHK)

12961 (SC-CR-720307) LIGHTNING ARRESTOR CONNECTOR. Group 2 Evaluation and Testing Development Report. Allen, L. J.; Olson, H. C. (Sandia Labs., Albuquerque, N. Mex. (USA)). Aug 1972. 184p. Dep. NTIS $11.25.

Twenty lightning arrestor connectors (MC2796 & 2797) were subjected to detailed electrical and environmental tests. Both the rutile sleeve and the anodized web concepts passed thermal and mechanical environments representative of those proposed for the W-66, 70, and 71. The connectors limited voltages below the requested 2500 volts during lightning simulated current pulses of 20 and 200 kiloamperes. D. C. voltage breakdowns exceeded 700 volts and insulation resistances were greater than 1000 megohms. The rutile sleeve design is recommended for production because that design provides less data scatter, lower impulse ratio and less moisture sensitivity than the anodized web concept. (auth)

12962 (SC-DR-720300) LIGHTNING ARRESTOR CONNECTOR. Group 2. Design, Fabrication, and Assembly. Olson, H. C.; Allen, L. J. (Sandia Labs., Albuquerque, N. Mex. (USA)). Aug 1972. 69p. Dep. NTIS $5.50.

Previous development activity suggested the dielectric stimulated arc concept could be used for a lightning arrestor connector. The proposed design, assembly procedures, and structural capabilities of the connector are described. Ten each lightning arrestor connectors using the titanium dioxide and aluminum oxide (anodize) dielectrics were assembled. Cleaning procedures, sealing materials and processes, and locating methods have been developed using currently available technology. Structural analysis indicates the connector body can withstand internal pressures to 340 atm; this exceeds the 180 atm maximum pressure predicted during 200,000 A lightning strikes. Calculations and hydrostatic pressure tests indicate that leakage of internal pressure starts at 140 atm at the encapsulant-pin interface. The design, assembly and test results included in this report plus electrical and environmental test results described in SC-DR-72 0307 meet the requirements proposed for the W66, 70 and 71 weapon systems. (auth)

12963 EVALUATION OF PINHOLES IN UNBACKED METAL FILM FILTERS TO BE USED IN ROCKET- AND SATELLITE-BORNE XUV SPECTROHELIOGRAPHS. Hunter, W.R.; Purcell, J.D. (E. O. Hulbert Center for Space Research, U. S. Naval Research Laboratory, Washington, D. C., 20375); Steele, G.N. Appl. Opt. 12: No. 8, 1874-1879 (Aug 1973).

Extreme ultraviolet (XUV) spectroheliographs require thin metal film filters that transmit the XUV radiation and eliminate scattered visible and near-uv radiation that would fog the photographic film on which the XUV images are recorded. Pinholes in the filters cause local fogging of the film during exposures in flight. It will be shown that the best way for preflight evaluation of pinhole effects is by using the filter in the flight instrument and photographing the sun from the earth's surface. An alternative method that appears to be as good, and is more convenient, is to test the filters in a simulated flight instrument. The results of evaluations using both the flight instrument and a simulated flight instrument will be shown. (auth)

12964 ISIS-II ATOMIC OXYGEN RED LINE PHOTOMETER. Shepherd, G.G.; Fancott, T. (University of Saskatchewan); Fancott, T.; McNally, J.; Kerr, H.S. Appl. Opt. 12: No. 8, 1767-1774 (Aug 1973).

One of the new features of the ISIS-II spacecraft, fourth in the Alouette/ISIS series, is the inclusion of two optical instruments. The scanning auroral photometer is described by Anger et al. in a companion paper. The red line photometer described here is similar in concept; it is designed to map the global distribution of the OI 6300-Å emission with a spatial resolution of about 100 km, a measurement accuracy of 10%, and a detection threshold of 10 R. The objective is to delineate the various processes leading to the excitation of $O(^1D)$ in the airglow and aurora by observing the global variation and by comparison with data from other instruments on board the same spacecraft. The device is now operating successfully in orbit, and detailed orbital performance characteristics will appear in a later publication. (auth)

12965 ISIS-II SCANNING AURORAL PHOTOMETER. Anger, C.D. (Physics Department, University of Calgary, Calgary 44, Alberta); Fancott, T.; McNally, J.; Kerr, I.S. Appl. Opt. 12: No. 8, 1753-1766 (Aug 1973).

The ISIS-II dual wavelength scanning auroral photometer is designed to map the distribution of auroral emissions at 5577 Å and 3914 Å over the portion of the dark earth visible to the spacecraft. A combination of internal electronic scanning and the natural orbital and rotational motions of the spacecraft causes a dual wavelength photometer to be scanned systematically across the earth. The data will be reproduced directly in the form of separate pictures representing emissions at each wavelength, which will be used to study the large-scale distribution and morphology of auroras, to study the ratio of 3914-Å and 5577-Å emissions (thought to depend upon the energies of exciting particles), and to compare with results from other instruments on board the spacecraft and on the ground. The Red Line Photometer experiment on the same spacecraft is described in an accompanying paper by Shepherd et al. The instrument can be thought of as the photometric equivalent of an all-sky color camera which will view the aurora from above instead of below and with a much wider vantage point unobstructed by cloud and haze. In one satellite pass, the instrument will be capable of surveying (in one hemisphere) the entire polar region in which auroras normally occur. (auth)

12966 NEW CARBON-ACTIVITY METER FOR HIGH-TEMPERATURE SODIUM. Ruther, W. E.; Skladzien, S. B.; Roche, M. F.; Allen, J. W. (Argonne National Lab., IL). Nucl. Technol.; 21: No. 1, 75-78(Jan 1974).

A metering system has been devised and tested which utilizes a solid-electrolyte oxygen-activity meter to measure the carbon activity in high-temperature sodium. The activity of the carbon is related to the activity of oxygen by the reactions: $C + CO_2 \rightleftharpoons 2CO$; $2CO + O_2 \rightleftharpoons 2CO_2$. Good agreement was obtained between actual calibration points and values calculated from thermodynamic considerations. (auth)

12967 PHOTOMETER FOR DETECTION OF SODIUM DAY AIRGLOW. McMahon, D.J.; Manring, E.R.; Patty, R.R. (Physics Department, North Carolina State University, Raleigh, North Carolina, 27607). Appl. Opt. 12: No. 8, 1806-1810 (Aug 1973).

Daytime, ground based measurements of sodium airglow emission are particularly difficult to perform. The ratio of airglow signal to Rayleigh and Mie scattering by the atmosphere as well as the very pronounced Fraunhofer structure lead to extraneous signals that are difficult to evaluate and require specialized techniques to eliminate. The photometer described can be characterized by the following principal features: (1) a narrow (4.5-Å) interference filter for initial discrimination; (2) cooled photomultiplier detector to reduce noise from dark current fluctuations and chopping to eliminate the average dark current; (3) a sodium vapor resonance cell to provide an effective bandpass comparable to the Doppler line width; (4) separate detection of all light transmitted by the interference filter to evaluate the Rayleigh and Mie components within the Doppler width of the resonance cell; (5) temperature quenching of the resonance cell to evaluate and account for instrumental imperfections. (auth)

12968 AUTOMATION OF CONTROL AND ANALYSIS IN THE CHEMICAL REPROCESSING OF FUELS. Perez, J. J. (CEN, Fontenay-aux-Roses, France). Bull. Inform. Sci. Tech. (Paris); No. 185, 73-78(Oct 1973). (In French).

The control of radioactive chemical installations led to the development of special analyzers for measurements of different

chemical elements in solution. The measurements can be effected on-line by the continuous monitoring of uranium, plutonium, free-acid and nitric acid, nondestructive measurements such as γ absorptiometry and conductometry being preferred. A multipurpose instrumentation (DIMA) was developed in the laboratory. The equipment is in the form of corrosion-resistant modules and utilizes a sequential sample processing procedure. This automation method, which utilizes a modular type of instrumentation in conjunction with modern methods of analysis enables better results to be obtained than with currently available facilities. (FR)

12969 DISTORTION IN THE MEASUREMENT OF TIME-INTERVAL DISTRIBUTIONS. Coates, P. B. (National Physical Lab., Teddington, Eng.). Nucl. Instrum. Methods; 113: No. 2, 311-312(1973).

A simple and accurate method of correcting for the distortion in measured time-interval distributions resulting from the dead time of the timing circuits is described. (auth)

12970 LIGHT COUPLED STAGE IN THE CAMAC HIGHWAY SYSTEM. Tebra, W.; Van Randeraat, B. (FOM Inst. for Atomic and Molecular Physics, Amsterdam). Nucl. Instrum. Methods; 113: No. 2, 201-205(1973).

In circumstances where high tension can cause damage to digital circuits and where common mode sources can interfere with the Camac signals, a light coupled stage will be helpful. The highway driver here described has been in use since January 1972 and drives different crates located over distances of about 100 m from the computer. The coupling stage isolates against differences in common mode potentials and protects against sudden high potential pulses occurring on experimenter side. Port input and output are according to the Camac specifications. (auth)

12971 SIMPLE DIFFERENTIAL DISCRIMINATOR. Rochelle, J. M. (Oak Ridge National Lab., TN). Nucl. Instrum. Methods; 113: No. 2, 315-316(1973).

A circuit was designed to detect anticoincidence for single-channel analyzers that have differential comparator inputs. This circuit, with one two-input gate and three ancillary transistors, is useful where size or cost must be minimized. (auth)

12972 PERIOD DETECTION INSTRUMENT FOR NUCLEAR REACTOR SAFETY SYSTEMS. Rusch, G. K.; McDowell, W. P. (Argonne National Lab., IL). Nucl. Instrum. Methods; 113: No. 2, 207-216(1973).

A reactor-period detection instrument featuring a high degree of freedom from scrams due to spurious signals has been designed, constructed, and tested. The technique employed is suitable for critical facilities and power reactors. Voltage level changes V(t) from a logarithmic amplifier are utilized to determine reactor period when signal levels are small, and both voltage level changes V(t) and the rate-of-change of voltage level dV(t)/dt are utilized when signal currents are large. Due to the low noise level of this hybrid circuit, the overall response speed of the log N amplifier and the dV(t)/dt period circuit can be significantly improved while greatly decreasing the chance of noise-induced scrams. (auth)

12973 TRANSMISSION EFFICIENCY OF FISSION PRODUCTS IN A HE-JET FLOW SYSTEM. Feldstein, H.; Amiel, S. (Soreq Nuclear Research Centre, Yavne, Israel). Nucl. Instrum. Methods; 113: No. 2, 181-184(1973).

Transfer efficiencies of ^{252}Cf fission recoils were studied, using a He-jet flow system, by measuring the x-ray spectra of the collected activity. The flow took place in capillaries 0.5 mm in diameter and up to 5 m in length, and the activity which emerged with a dispersion of $\leq 4°$ was collected at a pressure of 0.5 torr on graphite filters. The transfer efficiency of the light peak elements was found to be ~40%, while that of the heavy peak elements was ~70%, the difference attributed to effective fission recoil ranges. No elemental discrimination was observed over the entire range of fission products within the accuracy of the experiments (±10%). (auth)

12974 GAIN OF A CONTINUOUS CHANNEL ELECTRON MULTIPLIER IN MAGNETIC FIELDS. Otsuji, T. (Kobe Univ., Japan). Kobe Shosen Daigaku Kiyo, Dai-2-rui. Kokai, Kikan, Rigaku-hen; No. 20, 231-237(Jan 1973). (In Japanese).

Gain of a helical continuous channel electron multiplier, operated under the existence of external magnetic fields, was measured. When the intensity of the magnetic field was increased in one direction (this direction was regarded as a negative direction), the gain increased and then began to decrease. On the other hand, when the magnetic field was applied in an opposite direction (positive direction), the gain decreased and attained the minimum. A further increase of the field in this direction showed the similar behavior in the case of the negative magnetic field. The slope of the magnetic flux density versus the gain curve at the zero field was about 8%/gauss. To analyze the mechanism of the variation of the gain with magnetic field, Monte Carlo simulations of the electron multiplication process were performed. The gain obtained with the simulations agrees qualitatively with the observed value. The simulations show that, when the direction of the magnetic field is negative, multiplications are repeated mainly at the outer dynode surface, and, when a relatively strong magnetic field is applied in the positive direction, multiplications are repeated mainly at the inner dynode surface. In the positive weak field (about 20 gauss), electrons proceed zigzag and average flight lengths become long, so that the gain decreases due to the decrease of the number of the multiplication stages. (auth)

12975 ANALYZER FOR THIRD ELEMENTS IN A HYDROCARBON SAMPLE. Alessio, R. M.; Palmer, M. N.; Puzniak, T. J. US Patent 3,744,027. (to Gulf Research and Development Co.). 20 Nov 1973. Filed Date 12 Mar 1971. 12p.

An x-ray fluorescence analyzer for determining the sulfur content of hydrocarbons is described. The analyzer uses a rhodium/americium radioactive source and can also determine elements other than sulfur. (TFD)

12976 MEASURED DRIFT OF IRRADIATED AND UNIRRADIATED W3%Re/W25%Re THERMOCOUPLES AT A NOMINAL 2000 K. Heckelman, K. J. D.; Kozar, R. P. (Lewis Research Center, Cleveland). pp 1935-1949 of Symposium on Temperature. Part 3. Pittsburgh; Instrument Society of America (1972).

From proceedings of the 5th symposium on temperature; Washington, DC (21 Jun 1971).

Seven tantalum sheathed, BeO insulated, 0.157-cm-dia, grounded-junction W-3%Re/W-25%Re thermocouples were irradiated in a helium-argon environment at a temperature of 1900 to 2100°K. Six other thermocouples from the same lot were operated out-of-pile with the same temperature history as the in-pile thermocouples. Drift-in-pile was determined by periodically replacing a "reference" thermocouple in the irradiation capsule. Drift out-of-pile was determined with an optical pyrometer. After 8000 h irradiation, the estimated neutron fluence was 4×10^{21} thermal neutrons/sq cm and 0.9×10^{21} fast neutrons/sq cm (E greater than 0.18 MeV). At this time the in-pile group had decreased in output the equivalent of 340°K at 2073°K, while the out-of-pile group had decreased in output the equivalent of 54°K at 2073°K. The maximum deviation in drift between thermocouples of the in-pile group and between thermocouples of the out-of-pile group was less than ±15°K and less than ±10 K, respectively. (auth) (IAA)

12977 SPECTRUM GENERATOR USING A RANDOM SAMPLING TECHNIQUE. Falk, W. R. (Univ. of Manitoba, Winnipeg, Can.). Nucl. Instrum. Methods; 114: No. 1, 187-188(1974).

A simple spectrum generator suitable for the testing and setup of nuclear counting experiments is described. (auth)

12978 METHOD FOR QUANTITATIVE X-RAY FLUORESCENCE ANALYSIS IN THE NANOGRAM REGION. Aiginger, H.; Wobrauschek, P. (Oesterreichische Hochschule, Vienna). Nucl. Instrum. Methods; 114: No. 1, 157-158(1974).

Application of x-ray total reflection is used to reduce the background and to improve the ratio between signal and background so that measurements in the nanogram region can be made. (auth)

12979 COLD NEUTRON DIFFERENTIAL REFLECTION SPECTROMETER WHICH UTILIZES CYLINDRICAL REFLECTIONS. Ali, S. A.; Olson, N. T. (Massachusetts Inst. of Tech., Cambridge). Nucl. Instrum. Methods; 114: No. 1, 143-144(1974).

Cold neutron spectrometers of the differential reflection type have increased resolution if cylindrical reflectors, rather than planar reflectors, are utilized. The increased resolution of the cylindrical reflector results from the neutron beam-reflector angle of incidence remaining more constant over the beam area than is the case for planar reflectors. (auth)

12980 INEXPENSIVE TIMING SINGLE CHANNEL PULSE HEIGHT ANALYZER. Gottlieb, A. M. (Clark Univ., Worcester, MA). Nucl. Instrum. Methods; 114: No. 1, 193-194(1974).

A simple design for a leading-edge timing single channel pulse height analyzer (SCA) which uses integrated circuits is presented. (auth)

12981 FREQUENCY-TO-FLUX DENSITY READOUT CONVERTER FOR THE HVEC AUTOMATIC TRACKING NMR FLUXMETER. Walker, D. A. S. (Chalk River Nuclear Labs., Ont.). Nucl. Instrum. Methods; 114: No. 1, 195-196(1974).

HVEC NMR fluxmeters provide an output frequency which is proportional to magnetic field. Cascaded programmable TTL counters have been used to provide a suitable prescale factor that allows conversion to a direct flux-density readout. (auth)

12982 PROTON POLARIMETER FOR POLARIZATION TRANSFER EXPERIMENTS. Hardekopf, R. A.; Armstrong, D. D.; Keaton, P. W. Jr. (Los Alamos Scientific Lab., NM). Nucl. Instrum. Methods; 114: No. 1, 17-20(1974).

The design and operating features of a compact high-efficiency proton polarimeter are presented. This polarimeter is specifically suited for polarization transfer experiments in which the reaction is initiated with a polarized beam and the polarization along both axes perpendicular to the proton momentum must be measured. High-pressure helium gas is used as the analyzer, giving a smooth variation of analyzing power for 6 to 16 MeV protons. (auth)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

Isotope Separation (Industrial)

Refer also to abstract 13313.

12983 (CONF-700557–) FLUID MECHANIC PROCESSES IN GAS CENTRIFUGES. Lectures from the DFVLR-Colloquium, Porz-Wahn, May 14, 1970. Krause, E.; Hirschel, E. H. (eds.). (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Porz-Wahn (F. R. Germany). Inst. fuer Angewandte Gasdynamik). 1970. 167p. (In German and English).

The 12 papers in this conference have been previously abstracted in NSA. Abstract numbers for these papers can be found under CONF-700557 in the NSA Report Number Index. (TFD)

12984 (EP-RR-32, pp 170-193) PLASMA CENTRIFUGES. George, D. W. (Univ. of Sydney). Oct 1972.

From plasma physics seminar-1972 meeting; Canberra, Australia (9 Mar 1972).

The concept of plasma centrifuging for enrichment of uranium was first investigated by Slepian in 1942, without being developed into a successful technology. Recently, interest has been rekindled and experimental studies of rotating plasmas (Bonnevier, Watson–Munro et al.) show high rotational velocities and evidence of element and isotope separation. Some theoretical studies of high-pressure centrifuges at Sydney have shown interesting separation factors, and some preliminary experiments have been started with uranium metallic plasmas, with a view to avoiding the problems of the more common gaseous form of uranium, UF_6. A case is argued for more work in this area. (auth)

12985 ISOTOPE SEPARATION BY INFRARED LASER RADIATION. Belenov, E.M.; Markin, E. P.; Ovaevskii, A. N.; Romanenko, V. I. (Lebedev Inst. of Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 18: No. 3, 116-117(5 Aug 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 3, 196-198(5 Aug 1973).

It is shown that effective isotope separation from a gas mixture is possible by stimulation with laser radiation. The effect is physically connected with a discontinuity of the vibrational temperatures in a system of oscillators with different quantum energies at a low translational temperature of the gas. (auth)

Isotopic Power Sources

12986 (BNWL-363(Suppl.)) PROMETHIUM ISOTOPIC POWER DATA SHEETS. Fullam, H. T.; Van Tuyl, H. H. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Feb 1967. Contract AT(45-1)-1830. 19p. Dep. NTIS $3.00.

Declassified 30 Aug 1973.

The Pacific Northwest Laboratory has the responsibility of developing technology for the preparation and use of promethium as a radioisotope fuel in space, marine, and terrestrial power applications. Best estimates of the nuclear, chemical, and physical properties of promethium are summarized. Many of the physical properties have not yet been measured but estimates have been made based on measured values for neighboring rare earths. Technology has been developed (and demonstrated on a several hundred gram scale) to permit large scale preparation of highly purified promethium. The half-life and specific heat generation rate for promethium were measured, and its shielding requirements were studied. The existence of ^{148}Pm in production and power fuels was discovered, and its consequences investigated. Promethium sources up to 60 W were prepared and are being investigated for long term stability. Several megacuries of promethium have been set aside from Purex process solutions for use in the development program. (auth)

12987 (SLA-73-5508) SOIL BURIAL OF RADIOISOTOPIC FUEL CAPSULES. McCulloch, W. H. (Sandia Labs., Albuquerque, N. Mex. (USA)). [nd]. 10p. (CONF-731106-2). Dep. NTIS $3.00.

From thirteenth international conference on thermal conductivity; Lake Ozark, Missouri, USA (5 Nov 1973).

The safe burial in soil of a radioisotope heat source is an extremely complex problem, influenced by many parameters, including soil particle size, moisture content, weathering, density, inhomogeneities such as rocks and vegetation, soil disturbance upon impact, soil composition, and location on the earth. Precise descriptions of an accidental burial environment are in general impractical, if not impossible. Use of available analytical solutions simply to bracket a problem is less desirable than an analysis which treats directly the problem at hand. However, in the light of the difficulty in predicting accurately the post-impact environment, these approximate, bounding, relatively easy expressions provide a reasonable means for the design and/or safety evaluation of radioisotopic fuel capsules. More elaborate treatments probably would add little to the confidence in the results. (auth)

Radiation Sources

Refer also to abstract 13003.

12988 NON-RESONANT BACKGROUND AND RECOIL-FREE FRACTION OF A $BaSnO_3$ ^{119m}Sn MOESSBAUER SOURCE. Sitek, J. (Univ. of Exeter, Eng.). Nucl. Instrum. Methods; 114: No. 1, 163-164(1974).

The optimum thickness of Pd foil required to reduce the x-ray background emission for a thin $BaSnO_3$ ^{119m}Sn Moessbauer source has been measured. The recoil-free fraction of the ^{119m}Sn nuclei in the source has also been determined. (auth)

Design and Fabrication

12989 BETA-IRRADIATION APPARATUS. Mamin, E. B.; Makarov, V. A.; Korneeva, G. P.; Poppel, B. S.; Ivanov, V. I. British Patent 1,328,140. 30 Aug 1973. Filed date 6 Nov 1970. 5p.

Disadvantages of conventional β-irradiation units are discussed, including the lack of provision for varying the intensity and geometry of the radiation field and the fact that in charging and recharging the unit the total activity of the irradiator must be dealt with, making necessary the use of expensive "hot chambers" and remote-operated manipulators. In the apparatus described the irradiator is divided into at least two compartments, each of which has a source holder to accommodate a number of hermetic capsules containing the β-emitter. The activity of the β-emitter in each capsule and the number and relative arrangement of the capsules within each holder, and the number and relative arrangement of holders within each compartment, being variable, radiation fields of predetermined intensity and geometry may be obtained. The demountable construction of the irradiator simplifies charging and recharging. (UK)

12990 PREPARATION AND LINEWIDTH OF ^{121}Sb(Cu) MOESSBAUER SOURCES. Boolchand, P. (Univ. of Cincinnati). Nucl. Instrum. Methods; 114: No. 1, 159-161(1974).

A method for preparing ^{121}Sb(Cu) Moessbauer sources is given. The fwhm of these sources was found narrow and reproducible and a value of (5.83 ± 0.29) mm/s was observed with a thin ZnTe absorber. (auth)

Industrial Uses

Refer also to abstracts 12524 and 12541.

12991 (DP-MS-73-26) CALIFORNIUM-252: A NEW, PROMISING NEUTRON SOURCE. Corman, W. R.; Reinig, W. C.; Permar, P. H. (Du Pont de Nemours (E.I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). [nd]. Contract AT(07-2)-1. 43p. (CONF-720641-2). Dep. NTIS $4.25.

From seminar on the use and calibration of intense sources of radiation; Santiago, Chile (18 Jun 1973).

The history, production, and availability of ^{252}Cf and its many potential uses are reviewed. Applications in life sciences, education, chemical analysis, exploration for natural resources, industrial process control, neutron radiography, nondestructive inspection, and neutron flux enhancement are described. (auth)

12992 (INIS-mf-911, pp 34-36) FOOD IRRADIATION: PROMISE AND FULFILLMENT. Kahan, R. S. (Soreq Nuclear Research Center, Yavne, Israel). 1973.

From Israel Nuclear Society annual meeting; Yavne, Israel (26 Jun 1973).

The Israel national food irradiation program, initiated in 1964, concentrated mainly on fresh fruits and vegetables. Its main objectives, in order of decreasing priority, were: (1) sprout control of stored potatoes; (2) long-term preservation of onions; and (3) reduction of spoilage losses in export citrus. Secondary objectives were avocado, banana, garlic and cold-stored fruit. Other foodstuffs investigated included poultry meats, bread, and animal feeds. (INIS)

12993 (PEL-228) DISTRIBUTION OF ACTIVITY IN THE BATCH MILLING OF GOLD ORE ACTIVATED IN A NUCLEAR REACTOR. Exall, D. I.; Taute, W. J. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)). Apr 1973. 14p. Dep. NTIS (U. S. Sales Only) $3.00.

A series of batch grinding tests was performed on various size fractions of gold ore in a small 206 × 202 mm ball mill in order to determine the distribution of radioactivity through the products of breakage from a sample of ore which had been activated in the reactor at Pelindaba. Data are presented on the relative activity in various size fractions as a function of the time of grinding in the mill, and the use of this method of marking the ore in large-scale milling tests is discussed. (auth)

12994 PILOT PLANT STUDIES OF RADIATION INDUCED EMULSION COPOLYMERIZATION OF VINYL CHLORIDE WITH VINYL ACETATE. Tsai, J. T. Raleigh, NC; North Carolina State Univ. (1973). 136p. University Microfilms Order No. 73-29,586. Thesis (Ph. D.).

A flow reactor system was used to study the radiation induced emulsion copolymerization of vinyl chloride with vinyl acetate. Under the pressure of 100 psi, emulsion was recirculated from a stirred vessel through transfer lines to a tubular reactor located within a high intensity ^{60}Co source. The effect of physical chemical variables such as soap concentration, phase ratio, and feed composition on the rate of polymerization was investigated. The effect of certain engineering variables such as reaction temperature and residence time distribution on the molecular weight properties was also investigated. For a VCl/VAc feed ratio of 3.0 the rate of copolymerization was found to be proportional to the 0.17 power of the soap concentration. The rate decreases with an increase in agitation rate such that the agitation dependency is −0.35. Variation of the monomer-water ratio produces no significant change in rate, it affects the copolymer composition slightly. The rate increases with an increase in temperature over the range 5 to 50°C. The activation energy based on the rate was found to be 5.5 Kcal./mole. The average molecular weights of the copolymer increases with decreasing polymerization temperature; this is attributed to the moderate degree of occlusion changing the rate of propagation and termination abnormally. GPC measurements show $\bar{M}_w/\bar{M}_n$ averaging 1.85 for 10 runs. Addition of small amounts of mercaptan indicates that chain transfer has a strong effect of broadening the molecular weight distribution. The copolymer compositions are almost independent of conversion at low conversion levels. Copolymers produced in this system under 40% conversion were compositioned homogeneous. (Diss. Abstr. Int., B)

12995 TRACE DETECTION METHOD. Reifman, A.; Taylor, G. B. (to Astrophysics Research Corp.). British Patent 1,333,642. 10 Oct 1973. Filed date 17 Aug 1971. 8p.

A method is described for detecting the presence of materials such as explosives, arms, guns, etc., such as in baggage. The method comprises applying a tracer material to the suspect article. The tracer is selected from substances that emit prompt γ-rays when irradiated with thermal neutrons and which have a higher thermal neutron capture cross section than material under examination and the environmental material. This may include Gd or its oxide. The article is then irradiated with thermal neutrons the energy of which is such as to cause emission of prompt γ-rays from the tracer material without formation of radioactive material. These γ-rays are detected to give a first output signal. Background γ-rays and neutrons emitted from the article and environmental material are then detected to give a second output signal. The first and second output signals are then combined to allow compensation for background γ-rays and neutrons, and a third output signal is obtained which is representative of the presence of the suspected material. The neutron source may be Pu–Be. Examples of application of the method are given. (UK)

12996 COMPOSITE THREADS. Barthel, R.; Heger, A.; Mueller, W. (to Veb Kominat Technisches Glas Ilmenau). British Patent 1,331,094. 19 Sep 1973. Filed date 25 Sep 1970. 4p.

Reference is made to multifilar composite threads. The thread described comprises a number of filaments, each of which consists of an inorganic core with an unbroken adhering polymerized and/or cross linked high molecular weight organic layer which is formed upon the filaments by electron irradiation. The polymerizable substance may be a vinyl compound such as styrene or triallyl cyanurate. The monomer is chemically bonded to the surface of the inorganic filaments by radical formation and/or ion formation, and glasses rich in OH groups may be used as radical forming or ion forming substances. Enrichment of OH groups in the glass is achieved by the introduction of hydratable substances. Plasticisers for the organic layer may be included. The coated filaments may be arranged spirally in the multifilar composite thread. (UK)

12997 PIPE-LINE LEAK DETECTION METHOD AND DEVICE. Dorgebray, G. (to Elf Union). US Patent 3,778,613. 11 Dec 1973. Priority Date 17 Apr 1970, France. 8p.

For detecting and locating leaks in subterranean pipe lines which transport fluids, a radioactive tracer is circulated in the line, the line is flushed and a detection pig is moved along the line. A counting assembly in the pig monitors the radioactivity along the line and the distance from the starting point is printed each time the radioactivity exceeds a predetermined threshold. (Official Gazette)

LIFE SCIENCES

Radiation Effects on Cells

Refer also to abstract 15150.

12998 (COO-535-693, pp 56-58) NEURON DAMAGE BY ALPHA PARTICLES. Lett, J. T. (Colorado State Univ., Fort Collins); Powers, E.; Ristinen, R. A.; Smythe, W. R. 1 Nov 1973.
In Nuclear Physics Laboratory technical progress report, November 1, 1972–November 1, 1973.

12999 RELATION BETWEEN THE CHEMICAL EFFECTS OF ^{35}S DECOMPOSITION AND THE MUTAGENIC EFFECT OF $^{35}S \rightarrow {}^{35}Cl$ TRANSFORMATION. Pluciennik, H.; Kanski, R. (Univ., Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Chim.; 21: No. 7-8, 555-566(1973).
$^{35}S \rightarrow {}^{35}Cl$ transformation of incorporated ^{35}S causes mutations. In order to check the hypothesis that the mechanism of this phenomenon could consist in the initiation of DNA reactions by fragments of sulfur-containing products of cell destruction resulting from $^{35}S \rightarrow {}^{35}Cl$ transformation, the chemical effects of the decomposition of ^{35}S incorporated in $C_2H_5{}^{35}SH$ and $C_2H_5{}^{35}S\,C_2H_5$ were investigated. It was expected that in the case of the above-mentioned mechanism of mutagenic action of $^{35}S \rightarrow {}^{35}Cl$ transformation the stabilization of the primary molecular ions $[C_2H_5Cl\,H]^+$ and $[C_2H_5ClC_2H_5]^+$ in the chemical form of C_2H_5Cl would be insignificant. However, it was found that the stabilization of $[C_2H_5Cl\,H]^+$ in the form of C_2H_5Cl takes place in (47 ± 3%) and (83 ± 7%) depending on experimental conditions, and that of $[C_2H_5ClC_2H_5]^+$ in (68 ± 11%). Hence it was concluded that the above-mentioned mechanism of mutagenic effect of $^{35}S \rightarrow {}^{35}Cl$ transformation is improbable. (auth)

13000 THEORETICAL CONSIDERATIONS OF DOSE RATE FACTORS INFLUENCING RADIATION STRATEGY. Brown, B. W.; Thompson, J. R.; Barkley, T.; Suit, H.; Withers, H. R. (Rice Univ., Houston, TX). Radiology; 110: No. 1, 197-202(Jan 1974).
A model is proposed under which the effects of regimens of both fractionated high dose rate and continuous low dose rate irradiation can be simulated. Primary features of the model are cycle-related fluctuations in radiation response and the existence of a "single hit" killing component. The effects on cell killing of the dose rate or fractionation regimen chosen and of the proliferation kinetics of the tissue are examined. It is not possible to convert from a continuous regimen to a supposedly equally effective regimen of daily fractions unless the tissue kinetics are considered. (auth)

Radiation Effects on Plants

Refer also to abstract 13015.

Radiation Effects on Animals

Man

Refer also to abstracts 13000, 13030, 14486, 14502, 15080, and 15084.

13001 (ANL-8060(Pt. 2), pp 115-145) BONE MARROW DOSE FROM X-RAY EXAMINATION OF THE SKELETON. Schlenker, R. A.; Oltman, B. G. 1973.
Radiological and Environmental Research Division annual report, July 1972–June 1973.
A complete skeletal x ray examination was made of each radium patient. Estimates of the dose absorbed by the active marrow were made for four radium cases, and the values range from 56 to 180 mrad. The errors in the estimation procedure tend to cause overestimation at the upper end of the range and underestimation at the lower end of the range. Thus, the true dose values for these cases probably lie in a smaller range than the range of estimates quoted above. A typical dose delivered by the x ray examination during April 1973 was 80 mrad. The estimation procedure, the error of estimation, the effect of leakage through the collimator walls and x ray tube housing, the effect of repetition of exposures during a single examination, and the effect of changes in the projections included in the x ray examination are discussed. (auth)

13002 (ANL-8060(Pt. 2), pp 146-162) GONADAL DOSE FROM X-RAY EXAMINATION OF THE SKELETON. Schlenker, R. A. 1973.
Radiological and Environmental Research Division annual report, July 1972–June 1973.
Estimates of the male and female gonadal dose produced by x ray examination of the skeleton of radium cases are presented. The estimates are based on exposure data for four radium cases and are expressed as dose due to projections, which always include the gonads in the useful beam (the minimum dose) and possible additional dose due to projections which may or may not include the gonads in the useful beam. For men the minimum dose was in the range of 30 to 72 mrad, and the possible additional dose in the range of 83 to 150 mrad. For women the minimum dose was in the range of 46 to 390 mrad, and the possible additional dose in the range 73 to 220 mrad. The range of minimum doses for women shows the effect of contributions from a lumbar spot projection, which was deleted from the x-ray examination at the beginning of April, 1973. When the contribution from the lumbar spot is ignored, the range of minimum ovary doses becomes 46 to 87 mrad. Gonadal shields caused a substantial reduction of gonadal dose. (CH)

13003 (BNWL-SA-4687) IMPROVEMENTS IN DESIGN OF A $^{90}Sr-{}^{90}Y$ PORTABLE BLOOD IRRADIATOR. Hungate, F. P.; Griffin, B. I.; Cross, F. T.; Riemath, W. F. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). [nd]. Contract AT(4-1)-1830. 5p. (CONF-730974-1). Dep. NTIS $3.00.
From 26th conference on engineering in medicine and biology; Minneapolis, Minnesota, USA (30 Sep 1973).
Irradiation of blood in an exteriorized loop (extracorporeal irradiation of blood, ECIB) suppresses lymphocyte levels without damage to other body tissues. This is an effective adjunct or alternative to drug therapy for treating some forms of leukemia. Acceptance times of skin allografts have been extended by ECIB and the technique has been evaluated for its applicability for immunosuppression relative to renal allografts. Most treatments of both experimental animals and humans have been accomplished by shunting blood through large fixed equipment such as ^{60}Co, ^{137}Cs, or X-ray sources, thereby necessitating specialized facilities. With the relatively long treatment regimes required, this severely limits the numbers of patients who can receive treatment and requires the inconvenience and expense of hospitalization. A small inexpensive portable $^{90}Sr-{}^{90}Y$ γ blood irradiator is described that will permit chronic exposures of patients prior to and subsequent to kidney transplant. (CH)

13004 (FDA-74-8007) REVIEW OF DETERMINATIONS OF RADIATION DOSE TO THE ACTIVE BONE MARROW FROM DIAGNOSTIC X-RAY EXAMINATIONS. Shleien, B. (Bureau of Radiological Health, Rockville, Md. (USA)). Oct 1973. 21p. NTIS.
Steps required for determination of the mean active bone marrow dose from diagnostic x rays and the procedures employed by investigators in making such determinations are reviewed. In addition, a comparison is made of the results thus far obtained from all available studies. The purpose of this review of the literature is to provide background for planning additional determinations of active bone marrow doses. (55 references) (auth)

13005 (WASH-1273) EXPOSURE RATE REDUCTION ON BIKINI ISLAND DUE TO CONCRETE DWELLINGS. McCraw, T. F.; Lynch, O. D. T. Jr. (USAEC Nevada Operations Office, Las Vegas. Radiological Operations Div.). Jun 1973. 8p. NTIS $4.00.
During the May 1972 AEC sponsored resurvey of Bikini Atoll measurements were made to determine the reduction of γ exposure rates at dwelling sites due to the shielding effect of the concrete structures being erected for occupancy by the returning Bikini people. Exposure rates were measured at several points around and within each dwelling. Results showed that exposure rates present from radioactivity remaining post nuclear testing are reduced within the concrete dwellings by a significant amount. Upon completion of the housing construction effort, an exposure reduction factor of about 50% may apply. This is about what was expected provided materials of construction contained low levels of radioactivity. Even greater reduction can be expected when the housing area is covered with one to two inches of coral gravel as has been recommended. Depending on the occupancy time for residents of these houses, total exposure to external radiation can be expected to be reduced accordingly. External exposure rates measured ranged from 7 to 55 μR/hr, with an arithmetic mean value of 20 μR/hr. (CH)

13006 CERTAIN INVESTIGATION DATA ON THE RADIATION SAFETY OF X-RAY EXAMINATIONS. Telichko, F. F. (Uzhgorod

State Univ., USSR) Gig. Sanit.; No. 10, 49-52(Oct 1973). (In Russian).

Optimal conditions of x-ray examinations should provide a satisfactory quality of the image with a minimal extent of irradiation of the sick, i.e., with a minimal value of $r \times cm^2$ and intensity of irradiation dose. (auth)

13007 LATE SIDE EFFECTS OF ^{131}I TREATMENT OF HYPERTHYROIDISM. Hara, M.; Kitabatake, T. (Niigata Univ. Japan). Rinsho Hoshasen; 18: No. 8, 527-541(Aug 1973). (In Japanese).

Delayed effects of ^{131}I therapy such as hypothyroidism, thyroid cancer, leukemia, parathyroid abnormalities, stomach disorder, mammary gland disorders, and genetic defects are reviewed. Statistical data on the incidence of hypothyroidism are presented. Factors related to the incidence of hypothyroidism are ^{131}I dose, the number of ^{131}I administrations, weight of the thyroid, age, sex, past treatments, and combined use of antithyroidin. The following causes of hypofunction are inferred: autoimmunization, differences in radiosensitivity of cells, and retraction of thyroid tissue from vascular injury due to ^{131}I. The following measures are examined: curtailment of the ^{131}I dose; mass administration of ^{131}I and ^{129}I; and restriction of ^{131}I distribution used as a prophylactic measure. Although no significant increase was observed in the incidence of thyroid cancer or leukemia, neoplasia of thyroid nodes was frequently observed in young individuals. No increase in congenital anomalies was observed. (HLW)

13008 SENSITIVITY OF IRRADIATION IN CHROMOSOME LEVEL IN CHROMOSOMAL BREAKAGE SYNDROMES. Higure, S. (Tokyo Univ.). Shonika Rinsho; 36: No. 5, 599-602(May 1973). (In Japanese).

Peripheral lymphocytes in two cases with Bloom syndrome, one case with ataxia-telangiectasia, two cases with Fanconi anemia and three control cases were incubated for 52 hours using the Moorhead method. In addition, 10 and 100 rads of irradiation were given using the experimental ^{137}Cs unit. When the frequency per cell of chromosomal breakage in non-irradiated lymphocytes was calculated, the value was higher in cases with chromosomal breakage syndromes than that in the control cases. The rates of deletion per cell in the Bloom syndrome (150 cells in 2 cases), ataxia-telangiectasia (100 cells in 1 case), and Fanconi anemia (150 cells in 2 cases) of 10 rads-irradiated lymphocytes were 0.030 ± 0.028, 0.02, and 0.059 ± 0.007, respectively. The rates of dicentrics and rings were 0.015 ± 0.007, 0.010, and 0.026 ± 0.001, respectively, which were higher, as compared with 0.015 ± 0.007 of deletion rate and 0 of dicentrics and rings rates in normal cases (150 cells in 3 cases). In addition, deletion rate per cell in the Bloom syndrome (175 cells in 2 cases), ataxia-telangiectasia (100 cells in 1 case) and Fanconi anemia (103 cells in 2 cases) of 100 rads-irradiated lymphocytes were 0.145 ± 0.007, 0.180 and 0.259 ± 0.013, which showed higher value than 0.130 ± 0.010 of normal cases (150 cells in 3 cases). However, there was statistically no significant difference between abnormal and normal cases. The rates of dicentrics and rings per cell in three abnormal cases were 0.345 ± 0.049, 0.260 and 0.315 ± 0.032, respectively. In normal cases, it was 0.073 ± 0.011. Therefore, there was a significant difference between both cases. The rates of breaks per cell per rad in chromosome-type were 0.0071 ± 0.0036 in the Bloom syndrome (325 cells), 0.0055 ± 0.0025 in ataxia telangiectasia (200 cells), and 0.0103 ± 0.0016 in Fanconi anemia (253 cells), respectively. The level of significant difference was below 1% between those and control cases (300 cases) which was 0.0025 ± 0.005. (Japan)

13009 EFFECTS OF C-G (HYTHIOL) ADMINISTRATION DURING RADIOTHERAPY OF MALIGNANT NEOPLASMS WITH COBALT-60. Oshima, T.; Matsumoto, Y.; Aoyama, B. (Tokyo Teishin Hospital). Shinryo To Shinyaku; 10: No. 3, 551-556 (Mar 1973). (In Japanese).

Seventeen clinical cases of malignant neoplasms were treated with ^{60}Co irradiation, with administration of Hythiole (C-G), which contains 40 mg of cysteine and 60 mg of glucose in a dose of 6 tablets daily (2 tablets between each meal) when side effects of irradiation were observed. C-G administration was effective in 82% of the cases for radiation syndrome, nausea, and anorexia. Furthermore, throat pain was reduced by C-G administration in one case. Chromopexy induced by more than 1000 R irradiation on the skin lesion was improved in one case. Dysgeusia was not observed even with 4500 R irradiation for the cheek in one case. The shrinkage or disappearance of the lesion was observed in the radiograph of 10 cases of post-operational irradiation, four cases with lung cancer and one case with stomach cancer. In particular, metastases of lymphatic glands showed marked shrinkage and C-G administration was considered not to impede radiotherapy. (Japan)

13010 CLINICAL EFFECT OF PYRIDOXAL ON GENERAL PRURITUS AND ERUPTION ACCOMPANIED BY RADIOTHERAPY. Tedo, T. (National Hospital, Sendai). Shinyaku To Rinsho; 21: No. 11, 2017-2022(Nov 1973). (In Japanese).

Itching sensation, blood pictures, liver function, and electrolyte content before and after eruption were examined in 12 cases in total, seven with general and local pruritus, and five with eruption, of 210 cases with malignant tumors who received radiotherapy in the last one year and a half. The tumors of 12 patients consisted of five postoperative cancer of the breast, two cancer of the cervix of the uterus, one cerebral tumor, one postoperative cerebral tumor, one cancer of the tongue, and one cancer of the upper jaw. Three tablets of 30 mg of pyridoxal phosphate (Kyorin) were given in three divided doses a day as a main drug and glutathion was also given as a concomitant drug for the treatment of these symptoms. It was effective in nine cases, while ineffective in three cases, in which radiotherapy continued over two months and the total dose given by the date of appearance of the symptoms was too much, such as 12,000 rad of Telecobalt. The mechanism of development of these symptoms was considered, and the irradiation dose and the drugs during the treatment of tumors were suggested as the factors that caused these symptoms. (Japan)

13011 EFFECTS OF IRRADIATION ON THE HEART. Examination by ECG in Irradiated Cases of Breast Cancer After Operation. Matsubara, N.; Horiuchi, J.; Okuyama, T.; Adachi, T.; Taniguchi, K. (Tokyo Medical and Dental Univ.). Rinsho Hoshasen; 18: No. 5, 315-320(May 1973). (In Japanese).

Electrocardiographic (ECG) examinations were made before and within 10 days after irradiation in 50 cases (28 in the left side and 22 in the right side) of breast cancer irradiated after operation. Of 50 cases, there were abnormality of blood pressure and ECG or calcification of the arch of aorta in 23 abnormal cases (15 in the left side and 8 in the right side), and normal circulation system in 27 cases (13 in the left side and 14 in the right side) before irradiation. Post-operative irradiation was done using 170 kVp x rays, 200 kVp x rays, and ^{60}Co x rays. Irradiation doses were 3000 to 3500 R/(15-30 days) in the operative wound of the left side, and 2000 to 2500 R/(15-28 days) in the sternal region. Abnormal characteristics of electrocardiograms are described. In x-ray findings of the chest after irradiation, there were six cases with fibrosis of the lung and one case with metastasis of the lung field. No abnormality of ECG was seen. Average values of cardiothoracic ratio (CTR) before irradiation were 0.48 in normal cases and 0.51 in abnormal cases. (JA)

13012 ACTIVITY AND ISOZYME OF ALDOLASE IN CANCER OF THE CERVIX. Furuya, S. (Tokyo Medical Coll.). Tokyo Ika Daigaku Zasshi; 30: No. 6, 693-716(Nov 1972). (In Japanese).

The aldolase activity and isozyme in the tissues of cancer of the cervix were compared for study with those in the non-cancerous utero-cervical region. The aldolase activity (FDP) in the tissues of cancer of the cervix is about 2.3 times as high as that in the non-cancerous tissue, with 26.3 ± 9.6 in the former and 11.3 ± 4.1 in the latter. The classification of cancerous tissues by differentiation of tissues and studies on its relationship with activity showed that this activity is higher in the cancerous tissue of the mature type than in that of the premature type. As for a change in activity following irradiation with x-rays, the activity generally tended to decline upon irradiation, showing a 60.8% reduction on the average. By the DISC electrophoresis, 4 bands were confirmed for FDP, FlP aldolase isozyme respectively both in the non-cancerous and cancerous tissues; and, they were named ald_{1-4} from the cathodic side. Ald_1 increased by 2.1 times for FDP and 1.5 times for FlP in the cancerous tissue over the non-cancerous tissue, that $ald_{2,3}$ remained the same and that ald_4 showed a high percentage in the non-cancerous tissue inversely. As for a change due to x-irradiation, there was observed a tendency for ald_1 to decrease and for ald_4 to increase; and therefore, their patterns tend to shift from the cathodic side to the anodic side and to resemble those of the non-cancerous tissue, the degree of which varies with cases though. Tissues with a sharp decline of activity and a large change in patterns due to x-irradiation show a histopathological change, and a pronounced effect of x-irradiation. (auth) (Japan)

13013 SAFETY IN THE LABORATORY. Proceedings of the Interlab Symposium Held in London, England, June 1, 1973. London; Department of Trade and Industry (1973). 53p.

Six papers were presented, entitled: fire hazards, laboratory explosions, an approach to safety, the toxicity of chemicals, radiological hazards, some health hazards and methods of control. The paper on radiological hazards was in NSA scope and a separate abstract was prepared for it. (UK)

For an abstract of an individual paper see: 13014.

13014 RADIOLOGICAL HAZARDS. Butler, M. J. (National Radiological Protection Board, Belmont, Eng.). pp 32-37 of Safety in the Laboratory. London; Dept. of Trade and Industry (1973).

From interlab symposium; London, England (1 Jun 1973).

An account is given of some of the situations in which radiation hazards exist, and reference is made to a number of laws, regulations, and recommendations dealing with radiation protection. The services provided by the United Kingdom National Radiological Protection Board are described. The use of x rays in radiography and crystallography is discussed. The various problems arising in the laboratory from the use of x-ray, gamma, beta, and alpha sources are considered and recommendations made for appropriate monitoring, shielding and other safety measures in each case. (UK)

13015 EFFECT OF IONIZING RADIATION ON POPULATIONS (RADIATION-GENETIC ASPECTS). Dubinin, N. P.; Shevchenko, V. A.; Pomerantseva, M. D. pp 157-196 of Radioecology. Klechkovskii, V. M. (ed.). New York; John Wiley and Sons, Inc. (1973).

The genetic effects of ionizing radiation on populations are reviewed. A discussion is presented of factors affecting radiosensitivity of organisms such as number of chromosomes, ploidy, and molecular weight of nucleic acids. In a discussion of radioresistance it is pointed out that the resistance of cells and organisms to radiation varies with the sensitivity of genetic material in the cellular and ontogenetic cycles. Effects of short-term irradiation on populations including studies on fruit flies, algae, and Bikini Island populations are reviewed. Genetic load dynamics in long-term irradiation of populations are also reviewed. Other topics considered are effects of ionizing radiation on populations of laboratory mammals and genetic adaptation of populations to long-term irradiation. (HLW)

13016 CYTOGENETIC CHANGES FOLLOWING MEDICAL X-RAY EXAMINATIONS. Bairakova, D. A.; Dermendzhiev, Kh. T.; Ivanov, D. B.; Stavitskii, R. V. Gig. Sanit.; No. 10, 46-48(Oct 1973). (In Russian).

As the result of x-ray examinations cytogenetic changes may develop in cells of the blood-making organs and in lymphocytes of the peripheral blood. (auth)

Vertebrates

Refer also to abstracts 12727 and 12735.

13017 (CONF-730829-3) FUTURE RESEARCH IN MOUSE RADIATION GENETICS. Russell, W. L. (Oak Ridge National Lab., Tenn. (USA)). 1972. 8p. Dep. NTIS $3.00.

From thirteenth international congress of genetics; Berkeley, California, USA (20 Aug 1973).

The specific-locus method was used to investigate the effect of various biological and physical factors on radioinduced mutation frequency at a sample of seven gene loci of mice. The biological factors include sex, cell stage, and the interval between irradiation and fertilization. The physical factors include radiation dose, dose rate, dose fractionation, and radiation quality. It is suggested that the studies be extended to determine the effects of the various biological and physical factors on mutation frequency at low radiation dose rates in mouse spermatogonia and dictyate oocytes; investigations on the actual nature and effect of the individual mutations induced by radiation; and studies on the nature, extent, and persistence of the actual anatomical and physiological damage expressed in the descendents of irradiated populations. (CH)

13018 (COO-1754-12) EFFECTS OF WHOLE-BODY γ-IRRADIATION ON THE BIOSYNTHESIS OF CERTAIN SERUM PROTEINS. Progress Report, September 1, 1972–December 31, 1973. Neuhaus, O. W. (South Dakota Univ., Vermillion (USA). Dept. of Biochemistry). 1973. Contract AT(11-1)-1754. 10p. Dep. NTIS $3.00.

Whole-body γ irradiation stimulated the in vitro uptake of the model amino acid, α-aminoisobutyric acid (AIB) in rat liver. The Km was 5.1 and 9.2 mM for liver slices from normal and irradiated rats; Vmax increased from 10 to 25 μmoles/gm tissue/hr. When ^{14}C-cycloleucine was used as a tracer, irradiation increased the Na^+-independent component of transport. Although Na^+ ions are required, no stoichiometric relationship could be demonstrated. No effect of irradiation was observed on ^{22}Na uptake. Irradiation reduced the recovery of plasma membranes from liver homogenates. Although the membrane obtained was low in lipids, irradiation had not damaged either the ouabain-sensitive Na^+, $K^+(Mg^{++})$ATPase or the K^+-p-nitrophenylphosphatase. (auth)

13019 (COO-3269-5) FINAL COMPREHENSIVE REPORT OF OVERALL ACTIVITIES OF AEC CONTRACT AT(30-1)-3269 FROM ITS INITIATION. (Thomas Jefferson Univ., Philadelphia, Pa. (USA). Hospital). 1973. 11p. Dep. NTIS $3.00.

Research accomplishments are reported for the following projects: determination of the minimum level of x radiation in rats to alter the taste threshold; determination of the permanency of such alteration; determination of the dose and time dependency of the alteration; changes in hypothalamic function following low doses of ionizing radiation; development of new behavioral technique for determination of taste thresholds; correlation of taste sensitivity changes with alteration in taste bud morphology; effects of olfaction on taste thresholds; properties of taste material that influence x radiation effects on taste; determination of effects of in utero x-irradiation on taste function in the adult rat; and effects of ingestion of heavy metals on taste acuity and response of taste sensitivity to x radiation. (HLW)

13020 LOSS OF CHROMOSOMAL ABERRATIONS AS A RESULT OF GROWTH OF IRRADIATED RAT LIVER. Witcofski, R. L.; Pizzarello, D. J. (Bowman Gray School of Medicine, Winston-Salem, NC). Radiology; 110: No. 1, 209-212(Jan 1974).

Newly weaned and young adult rats were given single doses of 250 rads to the hepatic region and partially hepatectomized at various intervals up to seven weeks later. Levels of chromosomal bridges persisted undiminished in larger animals, whereas in smaller animals they decreased to approximately half of the initial number during the first three weeks, with no further change observed. Measurements of liver weight, total DNA, and mitotic levels after irradiation established that growth of the liver is more rapid in young animals. These aberrations are apparently lost during cell division related to cell growth. (auth)

13021 DEPRESSIVE EFFECT OF 7,12-DIMETHYLBENZ[A]-ANTHRACENE AND IONIZING IRRADIATION ON BONE MARROW COLONY-FORMING CELLS. Ball, J. K.; Hoshino, S.; McCarter, J. A. (Univ. of Western Ontario, London). J. Nat. Cancer Inst.; 51: No. 5, 1491-1495(Nov 1973).

Treatment of neonatal inbred CFW/D mice with 7,12-dimethylbenz[a]anthracene (DMBA) or γ-irradiation suppressed the number of colony-forming units (CFUs) or stem cells in the bone marrow. At 14 days after administration, DMBA (30 μg) had induced an 85% depression; at 60 days post treatment, there was still a 60 to 70% suppression. The extent and duration of the depression after the neonatal exposure to 400 rads (whole body) were similar. The permanent reduction in CFUs after neonatal irradiation contrasted sharply with the short-term effect of such a dose administered to adult animals. For both DMBA and irradiation treatment, the extent of the depression was dose dependent at low doses only. The effect of DMBA on the number of bone marrow stem cells was not merely quantitative: The CFUs remaining after treatment had a diminished ability to form spleen colonies on secondary transplantation. (auth)

13022 DIFFERENTIAL RADIOPROTECTION OF EUOXIC AND HYPOXIC MOUSE MAMMARY TUMORS BY A THIOPHOSPHATE COMPOUND. Utley, J. F.; Phillips, T. L.; Kane, L. J.; Wharam, M. D.; Wara, W. M. (Univ. of California, San Francisco). Radiology; 110: No. 1, 213-216(Jan 1974).

The radioprotective drug S-2-(3-aminopropylamino) ethyl phosphorothioate (WR2721) was evaluated in the EMT-6 mouse mammary tumor. Under euoxic conditions (DMF approximately 2), the drug protected the oxygenated portion of the tumor but not chronically hypoxic cells. Acutely hypoxic cells were protected to a slight degree. Since WR2721 has been shown to protect normal tissues with a DMF of 2 to 3, it is likely that decreased protection of anoxic tumor cells will be clinically useful. (auth)

13023 EFFECTS OF EXTERNAL IRRADIATION ON THE BODIES OF ADULT FISHES (CONSIDERATION IN DETAIL). Egami, N. (Tokyo Univ.); Eto, K.; Taguchi, Y. pp 92-173 of Radioactivity and Fishes. Contamination, Injuries, and Utilization. Egami, N. (ed.). Tokyo; Koseisha Kosei Kaku (1973). (In Japanese).

The effects of radiation on various organs of fishes are reviewed. Studies in the review include effects on hematopoiesis, histology and function of the digestive system, cell proliferation in the digestive epithelium, cell mass kinetics, and osmotic pressure changes in the gills, melanoblasts of the skin, the nervous system, sense organs, genital organs, kidneys, and bones. (HLW)

13024 SOMATIC EFFECT OF EXTERNAL IRRADIATION ON MATURE FISH (COMPENDIUM). Egami, N. (Tokyo Univ.); Eto, K. pp 65-91 of Radioactivity and Fishes. Contamination, Injuries, and Utilization. Egami, N. (ed.). Tokyo; Koseisha Kosei Kaku (1973). (In Japanese).

Experimental results of the somatic effect of external x and gamma irradiation on fishes are described, and life or death of the fish discussed at the organic and cellular levels. In order to

examine the lethal effect of radiation on fishes, experiments were conducted on the LD_{50} of goldfish. Studies of the tissues of the cell renewal system are described. These are important for investigating effects of radiation on the vertebrate. In the study in which killifishes were irradiated with various doses ranging from ¼ to 123 KR at one time and were raised under the standard conditions at 23°C for time-course observations of the proportion of survival organisms in an attempt to investigate the radioactive death of organisms and the critical organ, a 10-day effect occurred, i.e., at the exposure to 128 KR all organisms died instantaneously, whereas within the dose range from 64 KR to 4 KR almost all of the organisms survived for 10 days, and then died en masse. In addition, lesions were prominent in the intestinal epithelium, hematopoietic tissues, gill, sexual glands, and skin. All were not necessarily the critical organ for radioactive death since the 10-day effect appeared in some of them. In order to clarify further the relationship between cellular death and death of the organism, the survival time was examined in relation to temperature and lifespan of cells of organisms irradiated at various temperatures ranging from 0 to 40°C. The experimental results on the cause of renewal postulated from the effects of divided and low dose irradiations were summarized. Finally, the environmental conditions (water temperature, the concentration of salt, etc.) which influence the radioactive effect were examined using marine fishes and limnetic fishes, and examples of studies on the protection and intensification of radiation were mentioned. (JA)

13025 HEREDITARY EFFECT OF EXTERNAL RADIATION. Egami, N. (Tokyo Univ.). pp 174-201 of Radioactivity and Fishes. Contamination, Injuries, and Utilization. Egami, N. (ed.). Tokyo; Koseisha Kosei Kaku (1973). (In Japanese).

Biological influence of radiation consists of somatic and hereditary effects. The concepts of the latter effect are described and the recent state of studies is discussed based on 60 papers. Radiation effects on germ cells of fishes, the origin of germ cells, the proliferation of germ cells in the blastula and in fries, and gametogenesis in adult fishes were studied. Studies on lethal mutations can be divided into those with guppies and those with oviparous fishes. In studies with guppies, the number of fries delivered, the stillbirth rate, and mortality of fries were studied. The experimental studies with oviparous fishes, such as killifishes and trouts, revealed that the radiation effect was greater in the sperm than in the eggs. The mutations in visible characters were studied using guppies. Experiments with guppies were conducted in which exchange between X and Y chromosomes was induced by radiation. In the field of population genetics, there have been two practical studies: the investigation of the parthenogenetic inheritance of the ovoviviparous killifishes, especially that of Mollienesia formosa, which will be very useful in the studies on radiation effects, and the experiments of radiation tolerance with Gambusia affinis, which is easily affected by the environmental temperature. (JA)

13026 ABNORMAL VASCULARITY IN THE BRAIN MANTLE WITH X-RAY INDUCED MICROCEPHALY IN MICE. Kameyama, Y.; Hayashi, Y.; Hoshino, K. (Nagoya Univ., Japan). Senten Ijo; 12: No. 3, 147-156(Sep 1972).

The experiment was designed to examine the vascularity of the brain mantle of x-ray induced microcephaly in mice, in order to elucidate the pathogenesis of circulatory disorders that occurred postnatally and would play an important role for the manifestation of hydrocephalus. CF 1 female mice were exposed to a single whole-body x-radiation at a dose of 200 R on day 13 or 15 of pregnancy. The brains of the offspring were examined in vascular specimens with india ink injection and histological sections stained with H.E. or gallocyanine. Abnormal vascular patterns and poor vascular network of the neopallium were demonstrated in the microcephalic brains with aberrant cortical structure. A distinct correlation both in degree and in site between the abnormal vascular pattern and the histological aberration of the cortical structure was found. The results suggest a causal relationship between prenatal abnormal vascular formation in the brain mantle and cerebral venous congestion with hemorrhage manifested postnatally. (auth) (Japan)

13027 RADIATION, ICHTHYOLOGY, AND FISHERIES. Ichikawa, T. (National Inst. of Radiological Sciences, Chiba, Japan); Eto, K.; Egami, N. pp 30-64 of Radioactivity and Fishes. Contamination, Injuries, and Utilization. Egami, N. (ed.). Tokyo; Koseisha Kosei Kaku (1973). (In Japanese).

Effects of radiation on histology of fishes are reviewed. The review includes studies on mortality and survival time; effects on organs, gametes, and embryos; effects on genetics and reproduction; and effects on intestinal epithelium, hematopoietic tissue, the blood picture, ovulation, spermatogenesis, the nervous system, endocrine glands, skin pigmentation, behavior, immune reactions, and biochemical reactions. The review also includes studies on radioactivity of the seas and marine organisms, radioactive contamination of fishing boats, and names of research institutes conducting studies on radioactivity of fishes. (HLW)

Invertebrates

13028 MEDITERRANEAN FRUIT FLY: PROPENSITY TO FLIGHT OF STERILIZED FLIES. Schroeder, W. J.; Chambers, D. L.; Miyabara, R. Y. (Agricultural Research Services, Honolulu, Hawaii). J. Econ. Entomol.; 66: No. 6, 1261-1262(Dec 1973).

Sterilized (by irradiation) and untreated laboratory-reared Ceratitis capitata (Wiedemann) were studied in a specially designed flight-propensity chamber. Irradiation with 10 krad 2 days before adult eclosion produced a sedentary male and a very sedentary female, compared with the unirradiated counterparts and with native flies. The irradiated male and female were about 40 and 60%, respectively, less active than the native fly. The irradiated laboratory-reared fly also had a reduced potential for survival in a field cage and was eliminated in 6 to 9 days; the unirradiated fly was eliminated in 7 to 11 days. (auth)

13029 DEPRESSED FLOUR BEETLE: SENSITIVITY TO GAMMA IRRADIATION. Brower, J. H. (Agricultural Research Service, Savannah). J. Econ. Entomol.; 66: No. 6, 1318-1320(Dec 1973).

Ten krad of gamma irradiation to eggs and larvae of Palorus subdepressus (Wollaston) prevented the development of adults. Exposure of pupae to 5, 10, 20, 30, or 50 krad (but not 100) allowed some emergence, but longevity was greatly reduced. Adults were resistant to sterilizing effects of the radiation compared with other species of stored-product beetles: 30 krad was not completely sterilizing to either males or females, but the dose did greatly reduce fecundity, and longevity was significantly reduced: none survived for 3 weeks after a 20-krad exposure. Adults and pupae of this species would require higher doses of irradiation for effective control than would most other stored-product Coleoptera. (auth)

Radionuclide Effects (Internal Source)

Man

Refer also to abstract 13044.

13030 (ANL-8060(Pt.2)) RADIOLOGICAL AND ENVIRONMENTAL RESEARCH DIVISION ANNUAL REPORT, JULY 1972–JUNE 1973. (Argonne National Lab., Ill. (USA)). 1973. Contract W-31-109-eng-38. 336p. Dep. NTIS $10.00.

Separate abstracts were prepared for the 22 sections of this report. (CH)

For abstracts of individual sections see: 12515, 12696, 12758, 13001, 13002, 13031–13041, 13044–13048, and 13051.

13031 (ANL-8060(Pt. 2), pp 1-3) CHARACTERISTICS OF RADIUM-INDUCED MALIGNANT TUMORS OF THE MASTOID AND PARANASAL SINUSES. Littman, M. S. 1973.

Radiological and Environmental Research Division annual report, July 1972–June 1973.

The morphological characteristics of radium-induced carcinomas of the paranasal sinuses, mastoid air cells, and adjacent bones of 15 human patients with ^{226}Ra body burdens are summarized. The tumors showed similar gross characteristics. (CH)

13032 (ANL-8060(Pt. 2), pp 4-7) NOTE ON THE ANATOMICAL DISTRIBUTION OF PRIMARY BONE TUMORS IN THE LONG BONES OF RADIUM CASES. Littman, M. S.; Keane, A. T. 1973.

Radiological and Environmental Research Division annual report, July 1972–June 1973.

Data are summarized on the anatomical distribution of primary neoplasms in the long bones of nine patients with a body burden of ^{226}Ra. Additional data are reviewed on tumors of the long bones in radium patients for which no specific location on the bone could be determined from the available records. (CH)

13033 (ANL-8060(Pt. 2), pp 8-16) CELL-MEDIATED IMMUNITY IN RADIUM PATIENTS WITH AND WITHOUT OSTEOSARCOMA. Lloyd, E. L.; Menon, M.; Mitchen, J. L. 1973.

Radiological and Environmental Research Division annual report, July 1972–June 1973.

Cell-mediated immunity was measured in five persons, four of which had body burdens of ^{226}Ra greater than 1 μCi. Three of the cases had previously had amputations for osteosarcoma. Lymphocytes were separated from 10-ml blood samples and were then

diluted to give different concentrations and added to a known number of target cells from an osteosarcoma cell line. A measure of the lymphocyte cytotoxicity was obtained by counting the number of surviving target cells after 48 hours' incubation with the lymphocytes. In all tests the patients' lymphocytes were matched with samples taken from a normal control subject, and the blood samples were treated simultaneously. Only one of the patients showed a marked lymphocyte cytotoxicity to the target cells. This patient had a partial amputation for an osteosarcoma 20 years ago but currently showed no radiological evidence of recurrence of the disease. The follow-up of this patient will be extremely valuable in assessing the value of this test as a method for the early diagnosis of osteosarcoma. (auth)

13034 (ANL-8060(Pt. 2), pp 17-50) VIRUSES IN HUMAN TUMORS STUDIED IN FRESH SURGICAL MATERIAL AND IN TISSUE CULTURE. Lloyd, E. L.; Mitchen, J. L.; Menon, M.; Mackevicius, F.; Mitchen, J. R. 1973.

Radiological and Environmental Research Division annual report, July 1972–June 1973.

Virus particles were isolated from a lung tumor from a patient who had a body burden of 1.6 μCi ^{226}Ra grown in culture, as shown by their classical appearance in the electron microscope using negative staining techniques. No such particles were seen in normal lung tissue cultures. Virus-like particles were also seen with the electron microscope in thin sections prepared from surgically fresh material from the same tumor and in another adenocarcinoma, which exhibited similar foci-forming characteristics in culture. In a radium dial painter with a body burden of 1.6 μCi 30 years after ingestion similar virus-like particles were seen in fresh surgical material excised from a carcinoma of the mastoid. Speculation of the role of these viruses in the etiology of human cancer is premature before more carefully standardized work has been performed to study their identity and basic characteristics. (auth)

13035 (ANL-8060(Pt. 2), pp 81-91) CHROMOSOME BREAKAGE IN PATIENTS EXPOSED TO INTERNAL EMITTERS. Hoegerman, S. F.; Cummins, H. T.; Greco, I.; Smith, J.; Sonza-Novera, J. 1973.

Radiological and Environmental Research Division annual report, July 1972–June 1973.

Data are reported on chromosome changes in cultured lymphocytes from a large population of patients having ^{226}Ra body burdens. Data on unstable chromosome aberrations in phytohemagglutinin (PHA) stimulated lymphocyte cultures are presented and compared with similar data from previous studies. (CH)

13036 (ANL-8060(Pt. 2), pp 92-100) RELEVANCE OF THE LIFE HISTORY AND MITOGEN SENSITIVITY OF PERIPHERAL BLOOD LYMPHOCYTES TO CYTOGENETIC STUDIES OF RADIUM PATIENTS. Hoegerman, S. F.; Lund, D. E. 1973.

Radiological and Environmental Research Division annual report, July 1972–June 1973.

The use of cytogenetic assays of chromosome breakage in peripheral lymphocytes has proved practical as a dosimeter of radiation dose in cases of acute exposure to external sources. An attempt was made to adapt these methods to the dosimetry of internally deposited radionuclides, such as ^{226}Ra, which deliver a chronic dose predominantly to areas within and very near to bone. The life history of the various lymphocyte populations, especially their sites of origin, division, recirculation patterns, and life spans are reviewed in relation to the radiation dosages they receive. It is postulated that in patients with ^{226}Ra deposited in bones more chromosome damage will be observed in B lymphocyte cells derived from bone marrow than in thymus-derived T lymphocytes. (CH)

13037 (ANL-8060(Pt. 2), pp 101-110) UNSTABLE AND STABLE CHROMOSOME ABERRATIONS IN A RADIUM PATIENT WITH A HIGH PERCENTAGE OF ABNORMAL CELLS. Hoegerman, S. F.; Hodges, D.; Cummins, H. T.; Greco, I.; Smith, J.; Gabay, J. J. 1973.

Radiological and Environmental Research Division annual report, July 1972–June 1973.

A detailed study of both stable and unstable chromosome abnormalities in a single patient with a body burden of ^{226}Ra is presented. This patient was selected for detailed study because he had been the subject of previous detailed cytogenetic analysis, and was examined for evidence of any change in his level of abnormalities over time. An atypically high level of abnormalities in the patient suggest that his chromosome damage may not be a consequence of his radium burden. (CH)

13038 (ANL-8060(Pt. 2), pp 111-114) APPLICATION OF THE ALICE GENERAL-PURPOSE IMAGE PROCESSING SYSTEM TO KARYOTYPING CHROMOSOMES. Hodges, D.; Sonza-Novera, J.; Cummins, H. T. 1973.

Radiological and Environmental Research Division annual report, July 1972–June 1973.

The ALICE general-purpose image processing system was developed using a digital computer as an aid to karyotyping of chromosome spreads of cells from patients with ^{226}Ra body burdens. Short descriptions of the system and the karyotyping procedure are given. (CH)

13039 (ANL-8060(Pt. 2), pp 218-227) PRELIMINARY ANALYSES OF SOME MEASUREMENTS OF ^{231}Pa IN VIVO. Rundo, J.; Maletskos, C. J. 1973.

Radiological and Environmental Research Division annual report, July 1972–June 1973.

The radioactive content of a 67-year-old man was provisionally estimated to be 71 nCi ^{231}Pa, 51 nCi ^{227}Th, and 39 nCi ^{223}Ra 45 years after exposure to protactinium. Scans with an uncollimated counter suggested that the parent ^{231}Pa was confined to the lung. (auth)

13040 (ANL-8060(Pt. 2), pp 289-334) EXPOSURE DATA FOR RADIUM PATIENTS. 1973.

Radiological and Environmental Research Division annual report, July 1972–June 1973.

Data are summarized on radiation dose estimates for 1346 patients with body burdens of ^{226}Ra. Directly measured radium burdens and values for ^{226}Ra and ^{228}Ra are included. (CH)

Animals

Refer also to abstract 12735.

13041 (ANL-8060(Pt. 2), pp 51-80) VIRUSES IN OSTEOSARCOMAS INDUCED BY ^{226}Ra. A Study of the Induction of Bone Tumors in Mice. Lloyd, E. L.; Loutit, J. F.; Mackevicius, F. 1973.

Radiological and Environmental Research Division annual report, July 1972–June 1973.

Three groups (15 in each group) of 3-month-old mice were injected i.p. with ½ μCi ^{226}Ra. These groups were matched by similar control animals, which were not injected. Osteosarcomas were found in 40% of the male C3H/H mice and 80% of the female C3H/H mice, animals known to carry mammary viruses. No osteosarcomas were found in the female CBA/H mice, which have a very low incidence of both mammary tumors and leukemias. Viruses were observed in both mammary tumors and in osteosarcomas, which developed in the same animals. The possible association of virus in both types of tumors is discussed. (auth)

13042 (COO-1787-18) LYMPH NODE CLEARANCE OF PLUTONIUM FROM SUBCUTANEOUS WOUNDS IN BEAGLES. Dagle, G. E. (Colorado State Univ., Fort Collins (USA). Dept. of Radiology and Radiation Biology). Aug 1973. Contract AT (11-1)-1787. 138p. Dep. NTIS $9.00.

The lymph node clearance of ^{239}Pu O_2 administered as insoluble particles from subcutaneous implants was studied in adult beagles to simulate accidental contamination of hand wounds. External scintillation data were collected from the popliteal lymph nodes of each dog after 9.2 to 39.4 μCi of plutonium oxide was subcutaneously implanted into the left or right hind paws. The left hind paw was amputated 4 weeks after implantation to prevent continued deposition of plutonium oxide particles in the left popliteal lymph node. Groups of 3 dogs were sacrificed 4, 8, 16, and 32 weeks after plutonium implantation for histopathologic, electron microscopic, and radiochemical analysis of regional lymph nodes. An additional group of dogs received treatment with the chelating agent diethyenetriaminepentaacetic acid (DTPA). Plutonium rapidly accumulated in the popliteal lymph nodes after subcutaneous injection into the hind paw, and 1 to 10% of the implant dose was present in the popliteal lymph nodes at the time of necropsy. Histopathologic changes in the popliteal lymph nodes with plutonium particles were characterized primarily by reticular cell hyperplasia, increased numbers of macrophages, necrosis, and fibroplasia. Eventually, the plutonium particles became sequestered by scar tissue that often replaced the entire architecture of the lymph node. Light microscopic autoradiographs of the popliteal lymph nodes showed a time-related increase in number of alpha tracks per plutonium source. Electron microscopy showed that the plutonium particles were aggregated in phagolysosomes of macrophages. There was slight clearance of plutonium from the popliteal lymph nodes of dogs monitored for 32 weeks. The clearance of plutonium particles from the popliteal lymph nodes was associated with necrosis of macrophages. The external iliac lymph nodes contained fewer plutonium particles than the popliteal lymph nodes and histopathologic changes were less severe. The superficial inguinal lymph nodes of one dog contained appre-

ciable amounts of plutonium. Treatment with diethylenetriaminepentaacetic acid (DTPA) did not have a measurable effect on the clearance of plutonium from the popliteal lymph nodes. (60 references) (auth)

Nuclide Kinetics and Toxicology

Man

Refer also to abstracts 12715 and 13030.

13043 (AEC-tr-7498) PERMISSIBLE DOSAGE OF PLUTONIUM. Fushimi, Y. 11 Nov 1969. Translation of Japanese Report. 29p. Dep. NTIS $3.50.

Data on the biological effects of Pu were reviewed for use in the development of guidelines for the siting of nuclear reactors using Pu as the fuel. The lungs, liver, and bone tissues were identified as critical organs for Pu retention, and maximum permissible exposure limits for these tissues, as well as the whole body, are recommended. (CH)

13044 (ANL-8060(Pt. 2), pp 169-173) CONCENTRATIONS OF ^{226}Ra IN BONE FROM RADIUM-BURDENED PEOPLE. Holtzman, R. B.; Ilcewicz, F. H.; Sha, J. Y. 1973.

Radiological and Environmental Research Division annual report, July 1972–June 1973.

Preliminary results are presented on concentrations of ^{226}Ra in bones which were measured by radiochemical analysis of samples of exhumed skeletons or cremation ash. One to fourteen specimens were analyzed for each of nine subjects, and the average concentrations were within a factor of two of the values expected from γ measurements of the entire remains. Body burdens determined by γ counting ranged from 200 to 15,600 nCi of ^{226}Ra. (auth)

13045 (ANL-8060(Pt. 2), pp 174-187) METABOLIC BALANCES OF ^{210}Pb AND ^{210}Po AT NATURAL LEVELS. Holtzman, R. B.; Spencer, H.; Ilcewicz, F. H.; Kramer, L. 1973.

Radiological and Environmental Research Division annual report, July 1972–June 1973.

The metabolic balances of ^{210}Pb and ^{210}Po were measured in each of 12 men maintained on a metabolic ward. These nuclides were determined in urine and feces collected for one month or more from each subject, and in representative diets, drinking water, and atmospheric levels in the ward. The mean levels (± S.E.) were for ^{210}Pb and ^{210}Po, respectively, in diets over a period of five months (1.25 ± 0.04) and (1.63 ± 0.05) pCi/day, in urine (0.275 ± 0.026) and (0.269 ± 0.033) pCi/day, and in feces (1.333 ± 0.062) and (1.89 ± 0.10) pCi/day. The mean overall balances (the difference between diet and excreta) of (–0.235 ± 0.075) pCi ^{210}Pb/day and (–0.337 ± 0.100) pCi ^{210}Po/day show that over the collection period, larger amounts were excreted than taken in the diet. Atmospheric intake accounts for an additional ^{210}Pb intake of 0.07 pCi/day, but it contributes a ^{210}Po intake of only about 0.02 pCi/day (assuming a breathing rate of these subjects of 15 m^3/day). The contribution of cigarette smoke and dietary levels of calcium to the balances is discussed. (auth)

13046 (ANL-8060(Pt. 2), pp 190-196) INTERFERENCE FROM INHALED RADON IN THE MEASUREMENT OF LOW LEVELS OF RADIUM IN VIVO. Markun, F.; Huff, D. R. 1973.

Radiological and Environmental Research Division annual report, July 1972–June 1973.

A case study is presented that illustrates the effect of high radon levels in air on the determination of ^{226}Ra body content in patients. Questionable ^{226}Ra measurements of some low-level radium cases are considered. (auth)

13047 (ANL-8060(Pt. 2), pp 206-217) RETENTION AND ELIMINATION OF BERKELIUM-249–CALIFORNIUM-249 FOLLOWING ACUTE ACCIDENTAL INHALATION. Rundo, J.; Sedlet, J. 1973.

Radiological and Environmental Research Division annual report, July 1972–June 1973.

A case of accidental inhalation of a small quantity of an ignited mixture of ^{249}Bk and its decay product, ^{249}Cf, was studied by body radioactivity measurements (for ^{249}Cf) and excretion analysis (for both nuclides). The results obtained thus far cover the first year after intake. External measurements of the gamma rays from the ^{249}Cf indicated an approximate chest content of 3 nCi of this nuclide at the time of the first measurement (day 7). The 300-fold more abundant parent, ^{249}Bk, could not be detected. Subsequent measurements of the activity of the ^{249}Cf could be reasonably well described by the sum of two exponential components, 17% having a half-time of 25 days and the remainder a half-time of 1210 days. Except for an initial rapid clearance via the feces during the first 10 days, the urinary and fecal excretion rates of both nuclides increased with time until a maximum was reached 60 to 70 days after intake and thereafter declined. If the early fecal excretion was neglected, the results could be reasonably well described as the difference between two exponential components, one with half-times of 15 to 30 days representing the initial increase and one with half-times between 90 and 120 days representing the subsequent decrease in excretion rate. The increase suggests some change in the inhaled material after intake, possibly an increase in its rate of dissolution. (auth)

13048 (ANL-8060(Pt. 2), pp 228-241) MEASUREMENT OF MOCK PLUTONIUM IN VIVO. Rundo, J.; Eckerman, K. F.; Toohey, R. E.; Essling, M. A. 1973.

Radiological and Environmental Research Division annual report, July 1972–June 1973.

Three volunteers inhaled an insoluble aerosol labeled with ^{103}Pd and ^{51}Cr at Harwell, England, and they visited a number of laboratories in the U. S. A. and Europe. Our measurements of their radioactive content provided us with a preliminary calibration for the external counting of plutonium in lung. The method used to determine the ^{51}Cr content is described in detail, and some studies are presented on the effects of geometry and on the emission of the x and gamma rays from small (25 cm^2) areas of the chest of one subject. (auth)

13049 (LA-5445-C) PLUTONIUM AND ENVIRONMENTAL METALS IN MAN. Interlaboratory Meeting, May 9, 1973. Campbell, E.; McInroy, J. F. (Los Alamos Scientific Lab., N. Mex. (USA)). Nov 1973. Contract W-7405-eng-36. 10p. (CONF-730577-1). Dep. NTIS $4.00.

From plutonium and environmental metals in man conference; Albuquerque, New Mexico, USA (9 May 1973).

The various aspects of handling human autopsy tissues and methods used for the determination of Pu in tissues are discussed. Types of cases are classified as: the general population, with no known exposure to actinide elements; former AEC personnel which had an exposure potential; and Transuranium Registry cases representing known exposures to Pu and other actinides. It is pointed out that 5 millirem/yr has been proposed as the maximum permissible level of Pu for the general human population, which is equal to approximately three 1 μm particles of Pu deposited per person per year and the analytical chemist is confronted with what appears to be an almost insurmountable task to detect this level of Pu in man. The interlaboratory calibration of counting methods, using standards of ^{239}Pu, ^{238}Pu, and ^{236}Pu plated on stainless steel or samples of ashed beef bone, liver, and lung spiked with ^{239}Pu, is discussed. Methods used for the chemical preparation of the ashed tissue samples for radiometric analysis are reported. (CH)

13050 MAIN ORDER OF METABOLISM OF ^{232}Th AND OF ITS DECAY PRODUCTS IN THE BODY. Pavlovskaya, N. A. (Inst. of Industrial Hygiene and Preventive Medicine, Moscow). Gig. Sanit.; No. 11, 55-58(Nov 1973). (In Russian).

Analysis of published data and personal experimental research showed that the main parameters that characterize metabolism depend on the chemical nature of radionuclides, chemical properties of compounds, and their route of entry. Resorption of the thorium family (^{228}Th, ^{224}Ra and ^{212}Pb) depends first of all on the value of the ionic potential of ions. Distribution of radioelements in the body is determined by the route of entry, solubility of the thorium compounds, and stability of the complex ions. Kinetics of the radionuclides elimination is determined both by the chemical nature of the elements and by solubility of the thorium compounds in water. (auth)

Animals

Refer also to abstracts 12730, 12731, 12735, and 13042.

13051 (ANL-8060(Pt. 2), pp 163-168) FISSION TRACK AUTORADIOGRAPHS. Schlenker, R. A.; Oltman, B. G. 1973.

Radiological and Environmental Research Division annual report, July 1972–June 1973.

Autoradiographs of ^{239}Pu and of natural uranium distribution in bones of dogs were produced using the fission track technique. The experimental procedures are discussed. (CH)

13052 (COO-1787-20) TRANSLOCATION DYNAMICS OF ^{239}Pu. Bistline, R. W. (Colorado State Univ., Fort Collins (USA). Dept. of Radiology and Radiation Biology). Oct 1973. Contract AT(11-1)-1787. 167p. Dep. NTIS $10.50.

Thesis.

The translocation dynamics of ^{239}Pu$(NO_3)_4$ and $^{239}PuO_2$ from simulated puncture wounds in the paws of beagle dogs were studied. The difference between the more soluble Pu$(NO_3)_4$ form and the insoluble high fired PuO_2 particles was assumed to bring

about highly differing translocation dynamics from the wound site, through lymphatic channels into the system's circulation and to organs of deposition and of excretion. There was rapid movement of Pu from the paw to the first major lymph node with a resulting buildup and regression pattern for activity within the node. Differential translocation, concentration, retention, and excretion of Pu and Am were demonstrated with both chemical forms. The effectiveness of DTPA administration for Pu removal from the body was dependent on the chemical form of the Pu contaminant. (CH)

13053 UPTAKE OF THE RARE EARTH ELEMENTS INTO TUMORS. Higashi, T. (Kanagawa Dental Coll., Yokosuka, Japan); Fujimura, T.; Kanno, M.; Nakayama, Y.; Tomura, K. Rinsho Hoshasen; 18: No. 3, 188-190(Mar 1973). (In Japanese).

Mixtures of ^{67}Ga-citrate and chlorides of rare earth elements, such as ^{140}La, ^{141}Ce, ^{147}Nd, ^{152}Eu, ^{160}Tb and ^{177}Lu, were injected intraperitoneally into a mouse implanted with Ehrlich carcinoma. Simultaneous measurement of the γ spectrum in each organ was carried out after 48 hours by a Ge (Li) semiconductor detector, and the uptake of rare earth elements was compared with that of ^{67}Ga. Judging from the whole-body autoradiograms of the mouse with Ehrlich carcinoma, the uptake of ^{169}Yb into the bone was greater than that of ^{67}Ga, and it was more intensely incorporated in the bone tissue than in the marrow. Scintigrams of rats with Yoshida sarcoma also revealed that the uptake of ^{169}Yb into tumors and the bones was great. Comparing the uptake of ^{169}Yb into each organ with that of ^{67}Ga, the latter was greatly incorporated into tumors, and the former into the bones and also in a great amount into the site of inflammation. In the clinical experience with ^{169}Yb-citrate in lung cancer, the determination of tumor regions was difficult, because ^{169}Yb-citrate was greatly incorporated into the sternum and the thoracic vertebrae, and the differential diagnosis between tumor and inflammation was also difficult. ^{67}Ga is clinically very useful for evaluation of the effects of radiotherapy. ^{169}Yb has to be, however, treated with care, because of its long half-life, great uptake into the bones, and great exposure doses to the bones. (Japan)

New Tracer Techniques

Refer also to abstract 15099.

13054 (BNL-18375) TRANSMISSION SCANNING II. Alberi, J. L.; Kraner, H. W.; Bradley-Moore, P.; Atkins, H. L. (Brookhaven National Lab., Upton, N. Y. (USA)). 1973. 20p. (CONF-731112-13). Dep. NTIS $3.00.

From nuclear science symposium; San Francisco, California, USA (14 Nov 1973).

Work has been continued on the development of techniques for imaging spatial elemental distributions by means of differential absorption about the K-absorption edge of the particular element Z. A method to correct for spurious effects due to differential absorption in overlying absorber is described. Initial clinical studies of thyroid iodine images on patients are presented. Application of absorption edge transmission scanning to measurements of Ca content in thin in-vitro samples of rat bone is also discussed. An x-ray source with a broad energy spectrum was used. (CH)

13055 STANNOUS PYROPHOSPHATE LABELED WITH TECHNETIUM-99m FOR SKELETAL SCINTIGRAPHY. Hegesippe, M.; Beydon, J.; Bardy, A.; Panneciere, C. (CEN de Saclay, Gif-sur-Yvette, France). J. Nucl. Biol. Med.; 17: No. 3, 93-96(1973).

Methods for the preparation of ^{99m}Tc-labeled stannous pyrophosphate complex are described. Preliminary studies on rats, mice, and human patients indicate that 45% of radioactivity is quickly fixed by bone and 35% is excreted in urine within three hours following injection. It is concluded that bone scanning using ^{99m}Tc-labeled stannous pyrophosphate may be useful for the localization of suspected bone metastases from neoplasms. (CH)

13056 EVALUATION OF ^{125}I-IODODEOXYURIDINE AS A CELLULAR LABEL FOR IN VITRO ASSAYS: KINETICS OF INCORPORATION AND TOXICITY. le Mevel, B. P.; Oldham, R. K.; Wells, S. A.; Herberman, R. B. (National Institutes of Health, Bethesda, MD). J. Nat. Cancer Inst.; 51: No. 5, 1551-1558 (Nov 1973).

The kinetics of ^{125}IUdR incorporation and the toxicity of this compound for prelabeled mammalian tissue culture cells were examined. The compound was both radioactively and chemically toxic but at low concentrations it provided a reproducible means of labeling target cells for use in cytotoxicity assays. The implications of use of this compound in cytotoxicity assays are discussed. (auth)

13057 EVALUATION OF ^{51}Cr AS A LEUCOCYTE LABEL. Spivak, J. L.; Perry, S. (National Cancer Inst., Bethesda, MD). Brit. J. Haematol.; 25: No. 3, 321-330(Sep 1973).

A double label technique was developed to compare the behavior of ^{51}Cr-labelled leucocytes with DF^{32}P labelled leucocytes. Whole blood is divided into two aliquots and the leucocytes in each are labelled with a different isotope. After infusion of labelled cells, the radioactivity of each isotope can be determined simultaneously on the same blood sample using liquid scintillation counting. In studies of seven patients with solid tumours and one with leukemia, the intravascular disappearance of autologous leucocytes labelled with ^{51}Cr and DF^{32}P appeared similar in five of the eight patients during the initial 6 hr following infusion. Thereafter in all but one instance, ^{51}Cr labelled leucocytes had slightly higher specific activities. Chromium-51-labelled lymphocytes and DF^{32}P labelled lymphocytes also behaved in the same manner. It is concluded that ^{51}Cr is a suitable leucocyte label and may be substituted for DF^{32}P under certain circumstances. (UK)

13058 MEASUREMENT OF CIRCULATORY DYNAMICS IN THE LIVER BY RADIOISOTOPES. Nakagawa, M. (Kumamoto Univ., Japan). Rinsho To Kenkyu; 50: No. 1, 111-119(Jan 1973). (In Japanese).

In order to examine the dynamics of hepatic circulation, radioisotope (RI) methods are described for measuring hepatic blood flow, hepatic circulation time (circulation time from the spleen to the liver, and the starting time of the circulation through the portal vein and through the hepatic artery), ratio of the blood flow through the portal vein to that through the hepatic artery, and intra-and extrahepatic shunt and shunted blood flow. The liver accumulation coefficient (K_L) and disappearance coefficient in the blood (Kp) are reported to measure the hepatic blood flow. The patients, in whom the value of K_L was significantly different from that of normal group, were those with liver cirrhosis. In healthy persons, Kp was almost equal to K_L, but in advanced disturbances of the liver parenchyma cells and the portal circulation, such as liver cirrhosis, Kp was higher than K_L. The dynamics of the portal circulation was revealed relatively easily and within a short time by examining the circulation time from the spleen to the liver, and information concerning the complications, particularly esophageal varices, could be obtained. No evident results were obtained by the measurement of the starting time of the circulation through the hepatic artery and the portal vein. Injection into the hepatic vein, pulmonary arterial catheterization (^{131}I-HSA was used) and catheterization of the portal vein through the umbilical cord were tried to examine the ratio of hepatic arterial blood flow. The characteristics of the method of extrahepatic shunt (RIS, intrasplenic injection) and intrahepatic shunt (^{14}C-d galactose method) and portal perfusion scanning by heat-denatured human serum albumin labeled with ^{131}I (^{132}I-macroaggregated albumin) were described to detect the intra- and extrahepatic shunt and the shunted blood flow. (JA)

13059 EXPERIMENTAL AND CLINICAL STUDIES ON THE DIAGNOSIS OF CHRONIC PYOGENIC OSTEOMYELITIS BY THE USE OF RADIOISOTOPES (RI). Miyawaki, H. (Jikei Univ., Tokyo). Tokyo Jikeikai Ika Daigaku Zasshi; 88: No. 2, 269-293 (Mar 1973). (In Japanese).

Experimental pyogenic osteomyelitis was produced in rabbits; and scanning and external counting of ^{85}Sr as well as histopathological and roentgenographic examinations were conducted to compare the findings. A good agreement was found to exist between the histopathological findings and changes in roentgenogram and in profile and area scanning. A good correlation was also noted between the degree of disease activity as evaluated histopathologically, the wave height in curve of profile scintigram and the cpm by external counting technique. The clinical study was carried out on 114 patients, in whom both profile and area scanning was performed with the use of ^{85}Sr or ^{87m}Sr. From profile scintigrams thus obtained the ratio of surface areas of curves between the diseased and healthy tissues was estimated. This surface area ratio was classified into four grades. And this system of grading was employed as the criterion for evaluating disease activity. At the same time clinical findings and laboratory results were examined in correlation with the criterion. A significant correlation was found to exist between the criterion and the clinical picture and ESR. From photoscintigrams the extent of lesion was estimated. All these facts warrant the conclusion that the profile scintigram and photoscintigram, when used in combination with the conventional examination procedures, provide a means of great utility for diagnosing of chronic pyogenic osteomyelitis as well as for assessing the activity. (auth) (Japan)

13060 METHODOLOGICAL CONSIDERATION OF RADIOIMMUNOASSAY COMPARED WITH BIOASSAY. Nakano, R.; Kotsuji, F.; Kayashima, F. (Kobe Univ., Japan). Sanfujinka No Shimpo; 25: No. 3, 287-290(May 1973). (In Japanese).

When the 2nd international reference preparation of human menopausal gonadotropin is selected as the standard of gonadotropin in the urine, and the pituitary luteinizing hormone of the human (LER 907) is selected as standard of gonadotropin in the blood and the pituitary gland, the value obtained by radioimmunoassay in relation to that by bioassay is 1 to 1. In order to determine the statistical confidence limit of the value measured by radioimmunoassay, fractions A,B, and C of gonadotropin in the urine were measured by radioimmunoassay and bioassay. The precision index was 0.015 to 0.016 by radioimmunoassay and 0.15 to 0.21 by bioassay. The confidence limit of radioimmunoassay was 1000 times larger than that of bioassay and the precision index was one tenth. Radioimmunoassay is the only method for measuring immunoreactive hormones and difficulties remain in reproducibility of biological activity. (Japan)

13061 RADIOIMMUNOASSAY FOR PITUITARY HORMONES. Miyai, K.; Hashimoto, T.; Azukizawa, M.; Kumahara, Y. (Osaka Univ.). Rinsho Byori; 21: No. 4, 293-297(Apr 1973). (In Japanese).

Radioimmunoassays for thyroid-stimulating hormone (TSH), luteinizing hormone (LH), follicle-stimulating hormone (FSH) and adrenocorticotrophic hormone (ACTH) of anterior pituitary hormones were examined. TSH, FSH and LH were labeled with ^{131}I by the Hunter and Greenwood method, and the resulting radioactivities were measured after separating bound and free hormones by the double antibody technique. As for the reproducibility of this method, the coefficient of variation was 18.3 to 23.3% for different assays for TSH and 6.5 to 9.0% for the same assay. The coefficient of variation in different assays for LH was 15% and for FSH was 17% and that in the same assay for both was 5%. The characteristics of this method were that the effects of other pituitary hormones on the measured hormone were few and the dilution curve of the serum was parallel to or coincided with the standard curve in the measurement of the serum samples. The recovery rate of ^{131}I was 75 to 110%, when standard TSH was added to the serum of patients deficient in TSH. The levels of TSH, LH and FSH in the blood of patients with panhypopituitarism were less than the sensitivity of the measurement by this method. In primary hypothyroidism TSH level was high, and in primary hypogenitalism LH and FSH levels also were high. TSH in the blood increased after the administration of antithyroid agents and decreased after the administration of thyroid hormones. LH and FSH in the blood increased after the administration of gonadotropin. TSH in the blood increased markedly by the intravenous injection of 50 to 80μg TRH, which specifically secreted TSH, and LH and FSH in the blood increased by 100 μg of LH releasing hormone. Characteristic variations of LH and FSH were concomitant with menstrual cycle variations. The measurement values by this method were well correlated with the values by bioassay, but the absolute values were higher for bioassay values, although the reason was unknown. (Japan)

13062 RADIOIMMUNOASSAY OF LH. Motohashi, T.; Yogo, I. (Kyoto Univ.). Sanfujinka No Shimpo; 25: No. 3, 291-297(May 1973). (In Japanese).

The methods of isolation of binding free hormones (B/F), the double antibody method, adsorption method (dextran charcoal method), and precipitation method (dioxane method) were compared for the RIA of LH in the blood. Comparison of the standard curves revealed no difference among the three methods within measurable limits. The dextran charcoal method, a rapid quantitative determination, tended to be inferior in the variation and reproducibility of intraassay. The dioxane method was shown to be an excellent method in the convenience of procedures, precision, and reproducibility, except for the disadvantage of using an antigen-antibody system which is heterologous to LH. When changes in the LH values during menstrual cycles in normal mature women were examined, a large increase was observed in the phase of ovulation. In case of the administration of Enavid, an oral contraceptive, large fluctuations occurred in the LH value, indicating that ovulation was accompanied by an increase in LH. Changes in the blood LH before, during, and after the administration of Clomid, aimed at ovulation induction, were observed. (Japan)

MATERIALS

Ceramics and Cermets

Refer also to abstracts 12551, 12655, 12662, 12768, 13117–13119, 13121, 13127, 13155, 13156, 13164, 13215, 13227, 13230, 14640, 14844, 14845, 15125, 15154, and 15201.

13063 (CEA-CONF-2421) EXAMINATION OF THE REACTIONS BETWEEN OXIDE AND JACKET IN THE G 5 EXPERIMENT AT HIGH BURNUP RATIO. Conte, M.; de Keroulas, F.; Mikailoff, H. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). [nd]. 43p. (In French). (CONF-730726-6). Dep. NTIS (U. S. Sales Only) $4.25.

From symposium on fuel and elements for fast reactors; Brussels, Belgium (2 Jul 1973).

In order to study the performances of oxides at high burnup and particularly the interactions between oxide and jacket, a fuel element with mixed oxide base $(U_{0.8},Pu_{0.2})O_{1.97}$ and clad with 316 steel was irradiated with thermal neutrons to a burnup of 125,000 Mwd/t. The irradiation was made in a natural-convection device using NaK, giving a temperature difference between the top and bottom of the fuel element of about 200°C throughout the irradiation. Satisfactory behavior of the jacket was verified after the irradiation. Principal results presented are micrographic examination of the structure of the mixed oxide, study of the reactions occurring at the oxide-jacket interface, study of the influence of interior jacket temperature on the thickness of the reaction zones, and microprobe analysis of the constituents of the reaction zone on a sample in which the temperature of the interior of the jacket is about 720°C. (tr-auth)

13064 (COO-1676-28) CRYSTALLOGRAPHIC ORIENTATION DEPENDENCE OF INTERSTITIAL ANELASTICITY IN Ta–Re–N AND Ta–Re–O ALLOYS. Sagues, A. A.; Gibala, R. (Case Western Reserve Univ., Cleveland, Ohio (USA). Dept. of Metallurgy and Materials Science). 31 Oct 1973. Contract AT(11-1)-1676. 11p. (CONF-730844-3). Dep. NTIS $3.00.

From conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, F. R. Germany (27 Aug 1973).

The crystallographic orientation dependence of substitutional–interstitial (s–i) relaxations in Ta–Re–N and Ta–Re–O alloys is found to be consistent with that predicted by the selection rules of anelasticity for relaxations caused by defects with tetragonal or ⟨100⟩ orthorhombic symmetry. However, the large tetragonal distortion of single interstitials within s_2i type defects makes this conclusion uncertain. In general, extensive experiments on the orientation, concentration, and temperature dependence done with high accuracy and sensitivity are required to obtain more definite hints on the specific s–i defect configurations causing relaxation. (auth)

13065 (FRNC-TH-407) KINETICS OF THE CARBOREDUCTION OF URANIUM DIOXIDE. Danger, G. (Grenoble-1 Univ., 38 (France)). 1973. 59p. (In French). Dep. NTIS (U. S. Sales Only) $5.00.

Thesis.

An attempt was made to define the kinetics of the carboreduction of uranium dioxide as a function of pressure of the gas phase and temperature. The experimental work was carried out using a thermobalance, enabling the work to be performed in a carbon monoxide atmosphere (60 to 510 torr) at temperatures as high as 1818°C. Hypotheses are suggested on the structure of the carbide formed and the structure of the defects in order to explain the experimental results. (28 figures, 46 references) (FR)

13066 (GEMP-421-B) HIGHLIGHTS OF GE-NMPO RESEARCH, JANUARY 1965–JULY 1966. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). Jul 1966. 14p. Dep. NTIS $3.00.

Declassified 21 Sep 1973.

Results are presented on materials research to advance high-temperature reactor technology by developing improved and new materials and components and by developing a better understanding of the physico-chemical properties of these materials. The work is centered on areas such as unfueled and fueled metal hydrides for moderator and homogeneous fuel element–moderator applications and on control and shield materials for high-temperature reactors. Studies of the high-temperature behavior of urania, its stoichiometry, thermodynamic properties, compatibility and composition stability relative to refractory metals, and physical properties are summarized. The development of the technology of refractory-metal fuel element systems operating in non-oxidizing environments and the compatibility and stability of refractory metals with each other and with fuels at temperatures approaching the melting point of the refractory metal or fuel is reported. Results of studies on the burnup capability of an all ceramic fuel element system (BeO plus solid solutions of UO_2–Y_2O_3–ZrO_2 or UO_2–Y_2O_3–ThO_2) stable in inert or oxidizing atmospheres and with internal conversion capability are included. (auth)

13067 (GESR-2111) DEVELOPMENT OF A NUCLEAR THERMIONIC FUEL ELEMENT. Twenty-Second Periodic Progress Report, October 1, 1967–February 29, 1968. (General Electric Co., Pleasanton, Calif. (USA). Nuclear Thermionic Power Operation). 1968. Contract AT(04-3)-189. 137p. Dep. NTIS $9.00.

Declassified Jun 1973.

Research and development directed toward preparation of nuclear thermionic fuel elements and compact thermionic reactor systems are summarized. The research activities are reported for tasks associated with materials technology converter technology and irradiation, and thermionic reactor technology. (JRD)

13068 (IEA-276) VOLUMETRIC DETERMINATION OF U/O RATIO IN SINTERED PELLETS OF UO_{2+x} AND UO_{2+x} · ThO_2. Federgrun, L.; Abrao, A. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Oct 1972. 16p. (In Portuguese). INIS.

A technique for the O/U ratio determination in UO_{2+x} and UO_{2+x} · ThO_2 sintered pellets is outlined. Tetravalent uranium and total uranium are determined by titration after dissolution with phosphoric acid, with the aid of CO_2 during the titration, avoiding the oxidation of reduced uranium. The difficulties concerning the dissolution of the ceramic-grade oxides are overcome satisfactorily, especially for those oxides containing thorium. The titration of uranium IV in the presence of thorium is run with potassium permanganate, overcoming the difficulties found when the titration is tried with potassium dichromate. The thorium effect during the uranium titration is studied. The O/U ratio is calculated after the determination of total uranium and uranium IV, the content of uranium VI being calculated by difference. (auth)

13069 (LA-UR-73-1812) NEW ETCH FOR LIQUID METAL FAST BREEDER REACTOR MATERIALS. Bender, J. H.; Baker, C.; Johnson, K. A. (Los Alamos Scientific Lab., N. Mex. (USA)). [nd]. 12p. (CONF-730973-1). Dep. NTIS $3.00.

From 6th meeting of International Metallographic Society of America; Los Angeles, California, USA (25 Sep 1973).

Preparation and performance of an etchant composed of 10 ml HCl, 10 ml HBr, and 1 ml of HF for fuel and cladding is reported. Results of application of this etchant to irradiated UO_2–PuO_2 fuel specimens, stainless steels, and Incoloy 800 are described. (JRD)

13070 (N-73-27584) FABRICATION OF CAPSULE ASSEMBLIES, PHASE 3. Final Report. Keeton, A. R.; Stemann, L. G. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Mar 1973. Contract NAS3-15332. 128p. (NASA-CR-121181; WANL-M-FR-73-2). NTIS $8.50.

Thirteen capsule assemblies were fabricated for evaluation of fuel-pin-design concepts for a fast-spectrum lithium-cooled compact space power reactor. These instrumented assemblies were designed for real-time test of prototype fuel pins. Uranium mononitride fuel pins were encased in AISI 304L stainless steel capsules. Fabrication procedures were fully qualified by process development and assembly qualification tests. Instrumentation reliability was achieved utilizing specially processed and closely controlled thermocouple hot zone fabrication and by thermal screening tests. Overall capsule reliability was achieved with an all electron beam welded assembly. (STAR)

13071 (N-73-30509) OBSERVATION OF OXIDE PARTICLES BELOW THE APPARENT OXYGEN SOLUBILITY LIMIT IN TANTALUM. Stecura, S. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Sep 1973. 17p. (NASA-TM-X-2889; E-7530). NTIS $2.75.

The apparent solubility of oxygen in polycrystalline tantalum as determined by the x-ray-diffraction lattice parameter technique is about 1.63 at. % at 820°C. However, oxide particles were identified in samples containing as low as 0.5 at. % of oxygen. These oxide particles were present at the grain boundaries and within the grains. The number of oxide particles increased with increasing oxygen concentration in tantalum. The presence of oxide particles suggests that the true solubility of oxygen in the polycrystalline tantalum metal is probably significantly lower than that reported in the literature. (auth)

13072 (NP-19906) DENSIFICATION OF GENERAL ELECTRIC REACTOR FUELS. Supplement 1. (USAEC, Washington, D. C.). 14 Dec 1973. 41p.

The computer code ("GEGAP-III: A Model for the Prediction of Pellet-Cladding Thermal Conductance in BWR Fuel Rods") was formally submitted to the staff for review. A new report on GEGAP-III was also submitted which incorporates a model providing an exposure-dependent gap conductance. The new model also incorporates time-dependent fuel densification, time-dependent gap closure, and gap closure effects due to cladding creep-down. GEGAP-III is used to calculate the steady-state thermal performance of a fuel rod. This information is used as input for calculations of peak cladding temperature during loss-of-coolant accidents. The Staff's evaluations, conclusions, and recommendations of the GEGAP-III report and its supplement are presented. The results are applicable to all current design GE BWRs. The report is intended to be self contained. The output of the thermal performance code is an input to transient and accident calculations. Since changes were proposed in the transient and accident analysis models, they are not considered. (JRD)

13073 (SRARI-P-208) METHODS OF MATERIALS MECHANICAL TESTING UNDER IRRADIATION. Part I. Creep–Rupture Tests. Losev, N. P.; Samsonov, B. V.; Fin'ko, A. G.; Tsykanov, V. A.; Aver'yanov, P. G.; Tret'yakov, K. A. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR)). 1973. 33p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.75.

Experimental facilities and procedures are described that are used in the creep-rupture tests of rupture- and tubular specimens while pressurizing them in SM-2 reactor channels. (auth)

13074 (TM-62-6-15) FEASIBILITY STUDY OF APPLICATION OF A YTTRIA–URANIA FUEL ELEMENT REACTOR TO THE RAMJET MODE OF AN AEROSPACE PLANE. Nash, E. M. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). 16 Jan 1962. Contract AT(40-1)-2847. 27p. Dep. NTIS $3.50.

Declassified 31 Aug 1973.

A study was conducted to determine the feasibility of using an yttria–urania fueled reactor as a heat source for propulsion of an aerospace plane. It was found that use of an yttrium–urania fuel element reactor for the ramjet mode of operation of an aerospace plane does not appear practicable because of the limitations on operating temperatures about 3500°R of this type of fuel element. In addition, values of specific impulse during the ramjet mode, because of this same limitation, would be considerably lower than the values obtained utilizing a hydrogen-fueled air-breathing type of ramjet. It is concluded that any further studies should be directed towards the two-mode form of propulsion in which air-breathing hydrogen-fueled turbomachinery conceivably may be utilized up to Mach 4.5. However, the specific impulses obtained by a nuclear reactor would again be lower than the hydrogen-fueled turbo-accelerator system because of the lower allowable operating temperatures inherent with the nuclear reactor. Therefore, the application of nuclear power appears to be confined solely to the rocket mode of operation, which is from Mach 8 to 26 for the three-mode system, and Mach 4.5 to 26 for the two-mode system. (JRD)

13075 CHARACTERIZATION OF REFRACTORY METAL CARBIDES FOR ELECTRON PROBE REFERENCE MATERIALS. Ferguson, J. E.; Postma, F. W. Jr. (Union Carbide Corp., Oak Ridge, TN). Amer. Ceram. Soc. Bull.; 52: No. 12, 876-878(Dec 1973).

Niobium and zirconium carbides were prepared by vapor deposition techniques and extensively analyzed. The chemical characterizations, electron probe homogeneity studies, and precision of analysis for both the chemical and microprobe results are discussed. A comparison is made between electron probe results obtained using the prepared reference standards and similar results obtained using a well-accepted computer correction program (MAGIC II). These materials constitute a well characterized set of electron probe reference standards. (auth)

13076 DEVELOPMENT OF A RECORDING MAGNETOMETER, AND MAGNETIC PROPERTIES OF SOME TAU-PHASES IN $Co_{21}M_2B_6$. Jordan, L. T. Jr. Raleigh, NC; North Carolina State Univ. (1973). 88p. University Microfilms Order No. 73-29,554.

Thesis (Ph. D.).

An automatically recording vibrating-sample magnetometer with high and low-temperature accessories, built for measurement of ferromagnetic properties over a range of temperatures from −196 to 1000°C is described. This equipment was developed and built for a continuing investigation of the magnetic properties of ternary alloy compounds. Magnetic properties of a series of $Cr_{23}C_6$-type (tau) borides from the systems Co–In–B, Co–Mo–B, Co–Nb–B, Co–Sb–B, Co–Sn–B, Co–Zr–B, and from the substituted system $(Co, Ni)_{21}Sn_2B_6$, were examined to determine for alloys from each of these systems, the following: (1) classification according to the nature of their magnetic behavior (e.g., ferromagnetic, paramagnetic, etc., (2) Curie temperatures, (3) saturation magnetization at −196°C, (4) saturation magnetization moments at −196°C, and (5) atomic moments. Each of the selected cobalt ternary alloys was found to be ferromagnetic in behavior, and to have Curie temperatures in the range 125 to 384°C (compared with 1131°C for pure cobalt). Saturation magnetization at −196°C and the number of Bohr magnetons per atom were found to be as high as 9000 gauss (0.900 Wb/m^2) and 1.042 Bohr magnetons per atom for $Co_{22.13}In_{0.87}B_6$, and as low as 3280 gauss (0.328 Wb/m^2) and 0.462 Bohr magnetons per atom for $Co_{21}Sn_2B_6$. The alloys $Ni_{21}Sn_2B_6$ and $Co_3Ni_{18}Sn_2B_6$ were found to be paramagnetic while the substituted alloys $Co_{18}Ni_6Sn_2B_6$, $Co_{11}Ni_{10}Sn_2B_6$ and $Co_6Ni_{15}Sn_2B_6$ were determined to be ferromagnetic. Because of sample inhomogeneity, and consequently to the presence of other ferromagnetic phases in addition to the tau phase, it was not possible to properly evaluate magnetic properties of tau in these alloys. (Diss. Abstr. Int., B)

13077 ELECTRICAL PROPERTIES OF SOME NEW COMPOSITIONS IN THE $BaTiO_3$–MoO_3 SYSTEM. Chincholkar, V. S. (Inst. of Science, Nagpur, India). Curr. Sci. (India); 42: No. 19, 675(5 Oct 1973).

Dielectric constant (ϵ), loss tangent ($\tan\sigma$), ferroelectric properties, and conductivity were measured for MoO_3 contents from 0 to 3 mole %. ϵ, $\tan\sigma$, and spontaneous polarization increase with MoO_3 content up to maxima at 2 mole %; a constant value is reached at >3 mole %. The Curie point shows the opposite behavior, with a minimum at 2 mole %. Results are interpreted in terms of formation of BaO defects through $BaMoO_4$ formation. At MoO_3 contents >3 mole %, the samples become semiconducting. (DLC)

13078 THERMAL CONDUCTIVITY OF DIBORIDES OF GROUP IV–VI TRANSITION METALS. Samsonov, G.V.; Kovenskaya, B.A.; Serebryakova, T.I.; Tel'nikov, E.Y. (Institute of Problems in Materials Science, Academy of Sciences of the USSR, Moscow). High Temp. 10: No. 6, 1193-1195 (July 1973).

Room-temperature and high-temperature measurements (up to 2300°K) were made on the diborides of Ti, Zr, Hf, V, Nb, Ta, and Cr. Hot-pressed powder samples were used, and metallographic and x-ray diffraction analyses confirmed that the compounds consisted of only one phase each. The thermal conductivity of all the borides increased with temperature increase, explained by the electron component's becoming larger. (LMT)

13079 THERMAL CONDUCTIVITY OF SOME REFRACTORY CARBIDES AND BORIDES. L'vov, S.N.; Lesnaya, M.I.; Vinitskii, I.M.; Naumenko, V.Y. (N. K. Krupskaya Kherson Pedagogical Institute). High Temp. 10: No. 6, 1196-1198 (July 1973).

Results are reported of an experimental investigation of the temperature dependences of the thermal conductivities of the carbides TiC, ZrC, NbC, TaC, Cr_3C_2, Mo_2C and WC and of the borides TiB_2, ZrB_2, VB_2, CrB_2, Mo_2B_5, and W_2B_5 in the temperature range 300 to 1200°K. (auth)

13080 HIGH-TEMPERATURE DIELECTRIC BEHAVIOR OF Ca-DOPED CeO_2. Seitz, M. A.; Holliday, T. B. (Marquette Univ., Milwaukee). J. Electrochem. Soc.; 121: No. 1, 122-126 (Jan 1974).

The dielectric behavior of cerium dioxide with calcium concentrations ranging up to 8 mole % were investigated from 50 to 600 kHz and from room temperature to 1000°C. At temperatures less than 500°C and calcium concentrations less than 1.0 mole %, barrier layer polarization seemed responsible for the observed dielectric behavior. At larger calcium concentrations and higher temperatures, where ionic conduction predominated, the dielectric behavior was rationalized on the basis of a space charge polarization model involving mobile ionic point defects, which were blocked or partially blocked at the specimen electrodes, and electronic carriers, which were able to freely pass through the electrodes. The effective dielectric constant was found to increase exponentially with temperature with an activation energy of approximately 0.74 eV. (auth)

13081 TEMPERATURE AND COMPOSITIONAL DEPENDENCE OF THE ELECTRICAL CONDUCTIVITY OF NONSTOICHIOMETRIC CeO_{2-x}. Blumenthal, R. N.; Hofmaier, R. L. (Marquette Univ., Milwaukee). J. Electrochem. Soc.; 121: No. 1, 126-131 (Jan 1974). (COO-1441-17).

The electrical conductivity of sintered specimens of nonstoichiometric CeO_{2-x} was measured from 1000° to 300°C for compositions from $0.00424 \leq x \leq 0.178$. These results are described in terms of a high temperature and low temperature region. In both temperature regions, the conductivity for fixed values of x

exhibits an exponential dependence on temperature, $\sigma = \sigma_0 e^{-Q/kT}$. The temperature of the intersection between the high and low temperature regions for each composition agrees closely with the composition-temperature dependence of the miscibility gap reported by Brauer and Gingerich. The compositional and temperature dependence of the conductivity in the high-temperature region, which corresponds to a single-phase region, may be represented by the expression $\sigma \propto xe^{-Q/kT}$ where Q is a function of x. This expression is rationalized in terms of simple relations for the electron carrier concentration, $[Ce'_{Ce}] \propto x$, and the electron mobility, $\mu = \mu_0 e^{-Q/kT}$, where μ_0 is independent of x. For log x between −3.0 and −1.8, Q is constant at 0.22 eV, but increases to 0.37 eV at log x = −0.7. In the low-temperature region the activation energy, 0.61 ± 0.03 eV, was found to be independent of x. (auth)

13082 RANGE PROFILES FOR IONS IMPLANTED INTO ANODIC TANTALUM OXIDE. Pringle, J. P. S. (Atomic Energy of Canada, Ltd., Chalk River, Ont.). J. Electrochem. Soc.; 121: No. 1, 45-55(Jan 1974).

Radioactive $^{24}Na^+$, $^{42}K^+$, $^{85}Kr^+$, $^{86}Rb^+$, $^{135}Xe^+$, $^{134}Cs^+$, $^{204}Tl^+$, and $^{222}Rn^+$ were implanted at 0.5, 1, 2, 5, 10, 20, 40, 80, and 160 keV into anodic tantalum oxide. A sectioning technique, based on slow dissolution of the oxide in concentrated HF almost saturated with NH_4F, was used to obtain integrated range profiles, and these were analyzed for range parameters by means of a least squares fitting procedure. Range profiles at 5 keV and above could be described, within experimental error, as being normally distributed; the modal ranges and standard deviations increased with energy, and with decreasing mass of the implanting ion. The ratio between modal range and standard deviation was such that a portion of the normal distribution extended beyond the oxide surface; evidence showing that a similar fraction of the ions would fail to implant was discussed. Range profiles below 5 keV were much influenced by the nature of the oxide surface, and could be distinguished experimentally in three parts. The first part was located in the contaminant layer adsorbed on the oxide surface, the second in the immediate surface layer itself, and the third at greater depths in the oxide; this last corresponds to the range profiles observed at higher energy. At 0.5 keV, the profile in the third part could be fitted with an exponential; the change to a normal distribution at 5 keV has been interpreted in terms of Poisson statistics. (auth)

13083 COMPRESSIVE CREEP OF SINTERED UC–UN SOLID SOLUTIONS. Uchida, M.; Ichikawa, M. (Japan Atomic Energy Research Inst., Tokai). J. Nucl. Mater.; 49: No. 1, 91-97(Nov 1973).

Compressive creep of slightly hypostoichiometric uranium carbonitrides sintered from UC and UN powder mixture was studied at temperatures of 1310 and 1500°C. The creep rate as a function of C/N mole fraction showed a maximum near the composition N/(C + N) = 1/4 (in moles) and a minimum near N/(C + N) = 3/4. This behavior was correlated with the recent experimental evidence of the anomalies in the elastic constant and melting point, and thermodynamic discussions on the deviation of uranium carbonitrides from the ideal solution of UC and UN. (auth)

13084 DEVELOPMENT OF RARE-EARTH PYROHAFNATES FOR POWER REACTOR CONTROL-ROD MATERIALS. Spink, D. R. (Univ. of Waterloo, Ont.); Schemel, J. H. J. Nucl. Mater.; 49: No. 1, 1-9(Nov 1973).

Properly prepared mixtures of rare-earth oxides and hafnium oxide can be pressed and sintered to form exceptionally stable, dense, ceramic products possessing excellent control-rod properties. The characterization of the resulting rare-earth pyrohafnate powders and pellets are presented: thermal properties and absorption worths. (11 figures, 3 tables) (auth)

13085 KINETICS OF ACTINIDE REDISTRIBUTION BY VAPOR MIGRATION IN MIXED OXIDE FUELS. I. By Cracks. Olander, D. R. (Univ. of California, Berkeley). J. Nucl. Mater.; 49: No. 1, 21-34(Nov 1973).

The kinetics of vapor migration-driven restructuring and actinide redistribution along continuous cracks was studied analytically. The fissured fuel was modeled by a network of rectangular cracks with the temperature gradient along the major axis. Redistribution of fuel constituents was considered to occur by molecular diffusion in the gas filling the cracks. Hyperstoichiometric U–Pu oxide was treated so that only a single diffusing species (UO_3) needed to be considered, at least in the early stages of the process. The dependence of the kinetics upon oxygen-to-metal ratio, temperature gradient, and crack dimensions was investigated for fuel containing 20% plutonium. (11 figures, 22 references) (auth)

13086 KINETICS OF ACTINIDE REDISTRIBUTION BY VAPOR MIGRATION IN MIXED OXIDE FUELS. II. By Pores. Olander, D. R. (Univ. of California, Berkeley). J. Nucl. Mater.; 49: No. 1, 35-44(Nov 1973).

The migration velocity of a closed lenticular pore in hyperstoichiometric mixed oxide fuel was calculated, and the U/Pu ratio of the solid near the moving pore was determined. Pore migration in mixed oxides differs from the analogous process in pure stoichiometric urania in that the composition as well as the temperature of the two faces of the pore are different. It was found that pore migration is not as effective a mechanism of actinide redistribution as vapor transport along cracks. The velocity of the pores in $(U_{0.8}Pu_{0.2})O_{2+x}$ is ~$3^1/_2$ times faster than that in pure UO_2. (auth)

13087 PHASE TRANSITION STUDIES OF α^-, β^-, AND DELTA-U_3O_8. Momin, A. C.; Deshpande, V. V.; Karhanavala, M. D. (Bhabha Atomic Research Centre, Trombay, India). J. Nucl. Mater.; 49: No. 1, 98-100(Nov 1973).

The phase transitions were studied using high-temperature x-ray diffraction for lattice parameters, and a differential scanning calorimeter for temperatures and transition heats. Cell parameters are in good agreement with other data. β- and delta-U_3O_8 both transform to α (orthorhombic) U_3O_8 at 130°C, which in turn reversibly transforms to hexagonal U_3O_8 at 210°C. β- or delta-U_3O_8 are not obtained on cooling hexagonal U_3O_8 to room temperature. The transition heats are 380 cal/mole for $\beta \rightarrow \alpha$, 510 cal/mole for delta $\rightarrow \alpha$, and 15 to 20 cal/mole for $\alpha \rightarrow$ hexagonal. (DLC)

13088 THERMAL DIFFUSIVITY OF MONOCLINIC Eu_2O_3. Hunter, O. Jr.; Calderwood, F. W. (Ames Lab., IA). J. Nucl. Mater.; 49: No. 1, 103-104(Nov 1973).

A study was made of the thermal conductivity and diffusivity using the laser flash method at 100 to 1425°C. The Eu_2O_3 sample was pressed and sintered, then reoxidized; bulk density was 93.5% theoretical, and the grain size was uniform, ~10 μm. Results show a minimum at ~900°C; the thermal diffusivity fits the equation $\alpha = 0.01119 - 9.102 \times 10^{-6}\ T + 3.834 \times 10^{-9}\ T^2$. (DLC)

13089 TUGOPLAVKIE POKRYTIYA. (Refractory Coatings). Samsonov, G. V.; Epik, A. P. Moscow; Metallurgiya (1973). 400p.

Methods and technological schemes for making refractory coatings on machine parts and devices are discussed. Data are presented on physical and physico-technical properties, and work on the use of refractory coatings in metallurgy, machine construction, and equipment construction is discussed. The book is intended for engineering technology and scientific workers in the metallurgical, machine-construction, chemical, power, and other branches of industry and also for co-workers in organizations for scientific research on properties of materials. (131 figures, 108 tables, 462 references) (tr-auth)

13090 RADIATION-STIMULATED CONDUCTIVITY OF QUASI-AMORPHOUS LAYERS OF PYROLYTIC Cr ALLOYED WITH C. Korzo, V. F.; Chebotarenko, V. Ya. Fiz. Khim. Obrab. Mater.; No. 4, 34-37(1973). (In Russian).

Changes were found in the electrical properties of quasi-amorphous films of pyrolytic chromium alloyed with carbon in the process of self-decay of the agent due to thermal neutron irradiation. With increase in the neutron flux from 10^{13} to 5×10^{16} n/cm^2, the impure chromium film conductivity changed by several orders of magnitude. The nonlinear nature of the conductivity after annealing was related to the appearance in the structure of impure chromium of active capture centers, related to the presence in the matrix of quasi-amorphous chromium and atoms of carbon. (tr-auth)

13091 RADIATION DAMAGE IN BERYLLIUM OXIDE SINGLE CRYSTALS. Pigg, J. C.; Garrison, A. K.; Austerman, S. B. (Oak Ridge National Lab., TN). J. Nucl. Mater.; 49: No. 1, 67-74(Nov 1973).

Radiation damage in single-crystal BeO was studied using ^{60}Co gamma, 2-MeV electron, and epithermal neutron irradiations. The temperature of irradiation and the accumulated dose were kept within the range in which the change in the α lattice parameter was found to predominate. The observed changes produced by ^{60}Co irradiation are attributed to ionization of crystal impurities. Both electron and neutron irradiation produce optical absorption bands at about 5.25 and 6.5 eV. The energy at which the band peak occurs varies slightly with the conditions of irradiation and from sample to sample. No EPR resonance could be correlated with either band. Neither F^+ nor V^- centers were observed. The data from the annealing of these two bands indicate that they arise from different but related defects and that they are not due to simple point defects. (7 figures, 21 references) (auth)

13092 LA–NI–B SYSTEM. Kuz'ma, Yu. B.; Bilonizhko, N. S.; Nimkovich, E. M. (Lvov State Univ.). Dopov. Akad. Nauk Ukr. RSR, Ser. A; No. 10, 939-941(1973). (In Russian).

The diagram for phase equilibria in the system of La–Ni–B was plotted at 800 and 400°C by x-ray analysis. There are six compounds in the system. Data on the crystal structure of five of the compounds were obtained. (auth)

13093 ABSORBER MATERIALS FOR HIGH-TEMPERATURE GAS-COOLED REACTORS; IRRADIATION BEHAVIOR OF COATED LB PARTICLES. Strigl, A.; Bildstein, H. (Oesterreichische Studiengesellschaft fuer Atomenergie GmbH, Seibersdorf). Atomkernenergie; 22: No. 1, 37-40(Sep 1973). (In German).

Pyrocarbon-coated boron carbide/carbon particles ("LB particles") were irradiated in the ASTRA Reactor to a burnup of 83% of ^{10}B present. After irradiation, no defective particles could be detected by optical means. Subsequent micro gas determinations at 1,500°C made on single particles showed that about 50% of the helium formed was released into the free volume of the particles. The pressures resulting thereby were between about 50 and 90 atm. The results demonstrate the feasibility of these particles as HTGR absorber material. (GE)

13094 KINETIC CHARACTERISTICS OF SOLID SOLUTIONS TiC_xN_{1-x} AND $Zr_xNb_{1-x}C$. Borukhovich, A. S.; Dubrovskaya, L. B.; Matveenko, I. I.; Ordan'yan, S. S. Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 5, 710-713(May 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 5, 791-795(May 1973).

The temperature–concentration dependence of the thermo-emfs of the solid solutions TiC_xN_{1-x} (in the cross section of TiC–$TiN_{0.39}$), the Hall constant, and electrical resistance of the complex carbides $Zr_xNb_{1-x}C$ between 80 and 300°K. Extremes were found on the concentration dependences of the thermo-emf, the Hall emf, and the resistivity near the compositions $TiC_{0.5}N_{0.5}$ and $Zr_{0.6}Nb_{0.4}C$, respectively. Taken together with previously published results on the concentration–temperature dependences of the Hall emf and resistivity of the solid solutions TiC_xN_{1-x}, these results indicate that the conductivity mechanisms are the same in the complex carbides and in the carbonitrides of the transition metals. (auth)

13095 DEPASSIVATION OF HARD ALLOYS ON TUNGSTEN CARBIDE BASE DURING DIMENSIONAL ELECTROCHEMICAL TREATMENT. Davydov, A. D.; Grodzinskii, E. Ya.; Kamkin, A. N. (Inst. of Electrochemistry, Moscow). Elektrokhimiya; 9: No. 4, 518-520(Apr 1973). (In Russian).

13096 PHASE DIAGRAM OF THE SYSTEM Cs_2WO_4–$La_2(WO_4)^3$. Novikova, E. M.; Maier, A. A.; Tabunchenko, O. Ya. (Moscow Chemical-Technological Inst.). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 5, 787-788(May 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 5, 874-876(May 1973).

The phase diagram is based on data obtained using differential thermal, visual polythermal, crystal-optical, and x-ray phase analyses. (JRD)

13097 CONDITIONS OF FORMATION OF A SOLID SOLUTION OF ZrO_2 IN MgO. Ignatova, T. S.; Uzberg, L. V.; Perepelitsyn, V. A.; Gauer, G. V. Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 5, 721-723(May 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 5, 805-808(May 1973).

Results of investigations are presented that confirm formation of a solid solution of ZrO_2 in MgO. The maximal concentration of ZrO_2 in the solid solution above 2000°C is 5 to 6 wt.%. At the temperatures normally used for sintering periclase ceramics (1650 to 1700°C) the ZrO_2 concentration in the solid solution is less than 3 wt.%. The lower temperature limit of stability of the solid solution is about 1200°C. (auth)

13098 NEW MODIFICATIONS OF TUNGSTEN OXIDES. Palatnik, L. S.; Obol'yaninova, O. A.; Naboka, M. N.; Gladkikh, N. T. (Kharkov Polytechnic Inst.). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 5, 718-720(May 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 5, 801-804(May 1973).

New cubic modifications of W_2O_3 and WO_3 in thin condensed films were discovered. It was established that cubic WO_3 has a lattice of the ReO_3 type with one molecular unit per unit cell. It was also found that thin condensed films contain modifications, the lattices of which have a greater number of symmetry elements than thick specimens. (auth)

13099 X-RAY MICROPROBE STUDY OF SOLID SOLUTIONS IN THE SYSTEM Y_2O–HfO_2–SiO_2. Andrushchenko, N. S.; Parfenenkov, V. N.; Grebenshchikov, R. G. J. Appl. Chem. USSR (Engl. Transl.); 46: No. 6, 1427-1429(Jun 1973).

Translated from Zh. Prikl. Khim.; 46: No. 6, 1340-1342(Jun 1973).

These refractory oxides have combinations of valuable physicochemical properties and are extensively used in development of new materials. The microprobe investigations were carried out on solid-solution specimens. The study of monoclinic solid solutions based on HfO_2 in the HfO_2–SiO_2 system and cubic solid solutions of complex composition based on HfO_2 in the Y_2O_3–HfO_2–SiC_2 system shows uniform distribution of Si and of Y, Si, and Hf in the corresponding specimens. Results confirm macro-isomorphous miscibility of HfO_2 with silica in compositions with SiO_2 contents not exceeding 2.5 mole % and formation of imperfect solid solutions based on cubic HfO_2 with Y_2O_3 and SiO_2 in two of the compositions studied. (JRD)

13100 SYNTHESIS, CRYSTALLOGRAPHIC, AND MAGNETIC PROPERTIES OF $B_2O_3{\cdot}Fe_2O_3{\cdot}2MgO$ AND $B_2O_3{\cdot}Fe_2O_3{\cdot}4NiO$. Mihov, V. T.; Apostolov, A. V.; Taraleshkova, V. S.; Andreevska, V. G. (Univ., Sofia). Compt. Rend. Acad. Bulg. Sci.; 26: No. 7, 859-862 (1973).

Experimental results show that the purest compounds of both types were obtained by dissolving Fe_2O_3, MgO or NiO, and stoichiometric quantities of B_2O_3 in melted borax; the mixture was heated in a platinum crucible for 70 h at 1000°C and after cooling was treated using diluted nitric acid. The purity of the compounds was checked by means of x-ray structural analysis. The qualitative x-ray structural analysis revealed that these substances were indeed boroferrites while the quantitative x-ray structural analysis showed that the final product did not contain more than 3% impurities. The respective extinctions in the x-raygrams confirmed the correctness of the spatial groups determined for the $B_2O_3{\cdot}Fe_2O_3{\cdot}2MgO$ group it is D_{2h}^{16}-Pnam and for $B_2O_3{\cdot}Fe_2O_3{\cdot}4NiO$–$D_{2h}^{1}$-Pbam. The parameters of the crystalline lattice, measured by the Debye-Scherer method with chrome and iron radiation at large angles were: for $B_2O_3{\cdot}Fe_2O_3{\cdot}2MgO$—a = 9.254, 0.002 Å; b = 9.635, 0.002 Å; c = 3.017, 0.006 Å; and for $B_2O_3{\cdot}Fe_2O_3{\cdot}4NiO$—a = 9.230, 0.001 Å; b = 12.342, 0.008 Å; c = 3.003, 0.001 Å. The hitherto unknown magnetic properties of the compounds were investigated in a temperature range of 290 to 1300°K. Results of these measurements are presented in curves. (JRD)

13101 COATED BORON NITRIDE CONTAINING VESSEL. (to Union Carbide Corp.). British Patent 1,331,023. 19 Sep 1973. Priority Date 12 Mar 1971, USA. 4p.

A vessel is described for use in the vaporization of liquid metals. It is composed of a substantial percentage of boron nitride, together with a compatible refractory material such as titanium diboride or zirconium diboride, and is coated with a Zr–Si base alloy, readily wetted by molten metals. The coating increases the evaporation rate, thus assisting in metallization processes involving vapor deposition. (UK)

13102 FLUCTUATION EFFECTS ON THE CONDUCTIVITY OF Nb AND NbN FILMS. Chard, L. A. Minneapolis; Univ. of Minnesota (1973). 78p. University Microfilms Order No. 73-29,402.

Thesis (Ph. D.).

Standard four-terminal resistance measurements were done on sputtered Nb and NbN films to study the effect of fluctuations on the electrical conductivity. For one of the NbN samples, data were also taken in perpendicular magnetic fields up to 60 kG. Agreement of the data with the theory was only qualitative. The zero-field data seemed to indicate a change in sample dimensionality, a behavior also observed in the magnetic field data. However, the change took place at values of the magnetic field higher than predicted by theory. One way of reconciling this apparent discrepancy is to use in the theoretical expressions a smaller film thickness than that measured. This suggests that the granular structure of the superconductor affected the superconducting transition of the samples. This interpretation is supported by the high activation energy of the normal resistance as determined from the perpendicular field data. Even with this adjustment, however, difficulties remained. The behavior of the refractory films used here appears to be more complex than the description provided by the theory for homogeneous superconductors. (Diss. Abstr. Int., B)

13103 POLYMORPHISM AND PENFERROELECTRICITY IN PLZT CERAMICS. Meitzler, A. H.; O'Bryan, H. M. Jr. (Bell Telephone Labs., Inc., Murray Hill, NJ). Proc. IEEE (Inst. Elec. Electron. Eng.); 61: No. 7, 959-966(Jul 1973).

The interaction of structure with optical and electrical properties in lanthanum-doped lead zirconate-titanate (PLZT) ceramics is complex. An interpretation is presented which shows the critical dependence of structure and, hence, properties on the state of polarization, the temperature, and the La content. To explain the behavior of PLZT ceramics two new concepts are presented: polymorphism and penferroelectricity. Polymorphism occurs when either electrical or mechanical ordering fields generate a hybrid crystal structure in which an individual

grain attains a crystal structure dependent on its orientation with respect to the field. Penferroelectricity refers to the condition in which material is noncubic and polar but with such a low spontaneous polarization that no domains exist. (JRD)

13104 DIELECTRIC AND OPTICAL PROPERTIES OF A QUASI-FERROELECTRIC PLZT CERAMIC. Carl, K.; Geisen, K. (Philips Forschungslaboratorium, Aachen). Proc. IEEE (Inst. Elec. Electron. Eng.); 16: No. 7, 967-974(Jul 1973).

Certain compositions within the quaternary lead-lanthanum-titanate-zirconate (PLZT) system exhibit neither a "true" ferroelectric nor a "true" paraelectric behavior and are therefore best characterized as quasi-ferroelectric. The dielectric, hysteresis, and optical properties of quasi-ferroelectric PLZT ceramics have been investigated for the representative 9/65/35 composition which was prepared as a transparent ceramic by means of a two-stage sintering-densification process. The results of these studies suggest that the quasi-ferroelectric behavior of PLZT compositions between their Curie temperature and a transition temperature T_p is brought about by the existence of polar distorted microregions (polar short-range order). By applying an electric field a transition to a macroscopic ferroelectric (FE) state (polar long-range order) is enforced which is, however, not stable at zero field at $T > T_p$. This concept, which explains the experimental observations, is compared with the possibility of a FE to anti-FE phase transition at T_p. Attention is drawn to the quasi-static memory behavior of this type of material that can be realized by disconnecting the sample in its ON state from the voltage source and which might enlarge the scope of applications of quasi-ferroelectric PLZT ceramics. (auth)

13105 CALORIMETRIC CONTROL OF THE PLUTONIUM CONTENTS OF FAST FUEL ELEMENTS DURING DIFFERENT STAGES IN THEIR MANUFACTURE. Ganivet, M.; Meniere, J. M.; Lepoivre, A. (CEN de Cadarache, Saint-Paul-les-Durance, France). Bull. Inform. Sci. Tech. (Paris); No. 181, 33-40(May 1973). (In French).

The utilization of calorimetric methods to determine plutonium in plutonium-base nuclear fuels enables a rapid nondestructive control to be obtained for the various stages of manufacture. The apparatus described enables a control of the contents of between ±0.5 and 1% (depending on the size of the products examined and the quality of the calibration) to be achieved. The measurement time can vary between two and six hours, depending on the apparatus used. (FR)

13106 DEFECTIVE STRUCTURE AND THERMODYNAMIC PROPERTIES OF VANADIUM NONSTOICHIOMETRIC SESQUIOXIDE AT HIGH TEMPERATURES. Gerasimov, Ya. I.; Vasil'eva, I. A.; Balabaeva, R. F. (Moscow State Univ.). Dokl. Akad. Nauk SSSR; 211: No. 1, 98-101(1 Jul 1973). (In Russian).

Experimental data on thermodynamic properties of nonstoichiometric vanadium sesquioxides agreed with calculated values. The experimental data were determined by an emf method, using solid electrolytes and proportioned electrochemical changes in oxide composition. The partial thermodynamic functions of oxygen were determined for 7 compounds in the range $VO_{1.503}$ to $VO_{1.521}$ at temperatures from 1190 to 1360°K. From these data the basic types of defects in the compounds were determined and the excitation energies of the defects were found. Equations used for the calculated values are presented. (TTT)

13107 STRENGTH DEPENDENCE ON MICROSTRUCTURE CHARACTERISTICS OF SINTERED UO_2. Katanic-Popovic, J.; Petrovic, V. (Boris Kidrich Inst., Belgrade). Phys. Sintering; 5: No. 2/2, 95-105(1973).

From third international round table meeting on sintering; Herceg Novi, Yugoslavia (3 Sep 1973).

The effects of porosity on the tensile strength of UO_2 were studied. Tabulated data show that porous areas are the initiators of brittle fracture in sintered UO_2. It was found that the strength of dense sintered UO_2 is determined by porosity and the pore spatial distribution. (JRD)

13108 ANALYSIS OF SOME INITIAL SINTERING PARAMETERS OF REAL OXIDE POWDERS. Vlajic, M. (Boris Kidrich Inst., Belgrade). Phys. Sintering; 5: No. 2/2, 447-488(1973).

From third international round table meeting on sintering; Herceg Novi, Yugoslavia (3 Sep 1973).

Results of studies are presented on correlation of the shrinkage of UO_2 and Al_2O_3 compacts at initial sintering stages with mean particle size of the starting powders, particle packing, and pore structure. The results obtained during the initial sintering stage of agglomerated UO_2 powder compacts, indicate a dependence of shrinkage on the mean particle size as determined using ultrasonic deagglomeration. Reduced shrinkage of compacts with increased volume of pores greater than particle size is explained by vacancies in the particle arrays. Discrepancies found in the coordination numbers for Al_2O_3 are associated with a high degree of agglomeration and high content of γ-alumina. (JRD)

13109 USE OF MICRO-X-RAY SPECTRAL ANALYSIS TO INVESTIGATE THE PHASE $Y_2O_3 \cdot 4BaO \cdot B_2O_3$. Andrushchenko, N. S.; Bezrukova, E. A. Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 6, 858-959(Jun 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 6, 1071-1072(Jun 1973).

The phase was discovered by microscopic examination of thin sections of the crystallized melt. The chemical composition of the phase was determined by micro-x-ray spectral analysis. The theoretical values of the relative intensity of Ba and Y were calculated. A second phase occurring in the mixture is variable-composition solid solution represented as $xBaO \cdot yFe_2O_3 \cdot zB_2O_3$ with an admixture of Y_2O_3. (JRD)

13110 ELECTRICAL CONDUCTIVITY OF SCANDIUM OXIDE. Volchenkova, E. S.; Nedopekin, V. M. (Inst. of Electrochemistry, Sverdlovsk, USSR). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 6, 960-961(Jun 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 6, 1073-1074(Jun 1973).

Samples of SC_2O_3 used in the investigation were prepared by decomposing scandium ammonium carbonate. The electric conductivity of these specimens was measured at 900 to 1500°C in air, O, N, and Ar atmospheres. The electronic and p-type ionic components were calculated. The activation energy of the ionic component was found to be 2.40 eV. (JRD)

13111 THERMOEMISSION PROPERTIES OF REFRACTORY CARBIDE ALLOYS. Samsonov, G. V.; Bogomol, I. V.; Okhremchuk, L. N.; Podchernyaeva, I. A.; Fomenko, V. S. (Inst. of Problems in Materials Science, Kharkov). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 6, 951-953(Jun 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 6, 1064-1066(Jun 1973).

Research directed to increasing the heat resistance of TiC and ZrC by addition of Nb, Ta, Mo, or W is reported. Data tables are included that show the heat resistance of the cermets is much higher than that of the individual carbides. Data also show that it is possible to produce transition metal carbide systems possessing satisfactory thermoemission properties as well as higher heat resistance. (JRD)

13112 PHASE COMPOSITION OF THE SYSTEM $V_2O_5-Fe_2O_3$. Kurina, L. N.; Ediseeva, O. N. (Tomsk State Univ., USSR). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 6, 879-881(Jun 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 6, 983-986(Jun 1973).

In the system $V_2O_5-Fe_2O_3$, at Fe_2O_3 contents of less than 10%, solid solutions of substitution are formed with retention of the V_2O_5 lattice. This concentration range also contains V^{4+} ions, the appearance of which is facilitated by incorporation of ferric oxide into V_2O_5. At a 1 : 1 ratio of the components, $FeVO_4$ is formed; it melts at 874°C and has a high electrical conductivity. (auth)

13113 MAGNETIC SUSCEPTIBILITIES OF DODECABORIDES OF METALS WITH THE UB_{12} STRUCTURE. Odintsov, V. V.; Kostetskii, I. I.; L'vov, S. N. (Kherson Pedagogic Inst., USSR). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 6, 844-847(Jun 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 6, 944-947(Jun 1973).

The magnetic susceptibilities at 100 to 300°K of the dodecaborides YB_{12}, ZrB_{12}, TbB_{12}, DyB_{12}, HoB_{12}, ErB_{12}, TmB_{12}, YbB_{12}, and LuB_{12} with the UB_{12} structure were investigated. Dodecaborides of Tb, Dy, Ho, Er, Tm, and Yb have high magnetic susceptibilities that obey the Curie-Weiss law; this indicates that they possess localized magnetic moments. Their μ_{eff} differ from the corresponding values of the metals, owing to removal of f electrons and their involvement in interatomic bonds. The closed character of the f shells of Lu and Yb is violated in their dodecaborides; this is indicated by the very high values of their magnetic susceptibilities, the Curie-Weiss law being obeyed in the case of YB_{12}. The dodecaborides YB_{12} and ZrB_{12} have very low susceptibilities and these depend only weakly on temperature. These compounds evidently do not possess localized magnetic moments. (auth)

13114 CHANGE OF GRAIN SIZE FROM W POWDER TO WC CRYSTAL. Hara, A.; Miyake, M. (Sumitome Electric Industries Ltd., Itami, Japan). Monatsh. Chem.; 103: No. 5, 1465-1482(Sep 1972). (In German).

The change of grain size during each stage of the process was studied mainly by optical and electron microscopy. The grain size has a marked effect on the properties of cemented carbide. In order to determine the process of formation of WC powder, the cross section and the surface of the carburized powder were

examined microscopically. The mechanisms of carburization and grain growth were clarified. Grain growth in sintering and the effect of grain size distribution were also studied. It was concluded that grain growth begins long before the appearance of the liquid phase. It is pointed out that the inner structure of WC should be studied at the atomic level. (auth)

13115 RAMAN SPECTRUM OF GADOLINIUM MOLYBDATE ABOVE AND BELOW THE FERROELECTRIC TRANSITION. Ullman, F.G.; Holden, B.J. (Electrical Materials Laboratory, Department of Electrical Engineering, University of Nebraska, Lincoln, Nebraska 68508); Ganguly, B.N.; Hardy, J.R. Phys. Rev. B 8: No. 6, 2991-2998 (15 Sept 1973).

90 °-scattered Raman spectra of single-domain gadolinium molybdate have been obtained at room temperature and above the 159 °C ferroelectric transition on several crystal orientations. Lines in the 0–200-cm^{-1} range can all be associated with Raman-active phonons and are identified by symmetry considerations, scattering-efficiency calculations, and comparison of spectra for different crystal orientations. Lines in the 200–1000-cm^{-1} range can be identified with coupled vibrations of tetrahedral molybdate ions. Spectra for frequencies above 1000 cm^{-1} originate from impurity flourescence. The effect of the presence of multiple domains on the spectra was determined; the observed differences between single-domain and multiple-domain crystals result from B_1–B_2 symmetry mixing from the twinning of adjacent domains. No new soft modes, in addition to the known soft mode at about 43 cm^{-1}, were observed. A few of the lines that are present in only the low-temperature phase cannot be identified from symmetry analysis and are probably derived from zone-boundary modes of the high-temperature phase. (auth)

13116 INVESTIGATIONS REGARDING STRUCTURE, PREPARATION, AND HARDNESS PROPERTIES IN THE SYSTEM Ta-Hf-C-N. Komac, M. (Institut Jozef Stefan, Ljubljana, Yugoslavia); Thuemmler, F. Planseeber. Pulvermet.; 21: 88-109 (Jun 1973). (In German).

Tantalum carbonitrides and tantalum–hafnium carbonitrides were obtained in the form of powders. Specimens were prepared by compressing powder mixtures at temperatures in the range from 2000 to 2600°C. Hardness was determined with the aid of the Vickers method. Contents of total carbon, free carbon, nitrogen, and oxygen in the specimen were analytically determined. The dependence of lattice parameter length and hardness on composition is discussed. (IAA)

Metals and Alloys

Refer also to abstracts 13073, 15101, 15115, 15148, and 15155.

13117 PLUTONIUM-DOKUMENTATION. Transplutonium-Elemente. Referate-Zeitschrift. Band 7, Heft 7-9. 3. Vierteljahresregister 1973. (Plutonium-Documentation. Transplutonium Elements. Abstract Journal. Volume 7, No. 7-9. 3rd Quarter Index). Karlsruhe, Ger.; Gesellschaft fuer Kernforschung mbH (1973). 80p.

13118 PLUTONIUM-DOKUMENTATION. Transplutonium-Elemente. Referate-Zeitschrift. 186 Referate (Register-Nr. 4029-4364) 86 Referate (Register-Nr. 737T-822T). (Plutonium-Documentation. Transplutonium Elements. Abstract Journal. 186 Abstracts (Register No. 4029-4364) 86 Abstracts (Register No. 737T-822T)). Karlsruhe, Ger.; Gesellschaft fuer Kernforschung mbH (1973). 123p.

13119 2nd ELECTRON BEAM PROCESSING SEMINAR, FRANKFURT AM MAIN, GERMANY, JUNE 26–29, 1972. Silva, R. M. (ed.). Dayton, OH; Universal Technology Corporation (1972). 563p. (CONF-720696-).

From 2nd electron beam processing seminar; Frankfurt am Main, F. R. Germany (26 Jun 1972).

Nineteen papers were presented at the seminar. A separate abstract was prepared for each of 12 papers considered in the scope of NSA. (JRD)

For abstracts of individual papers see: 13120, 13121, and 13155–13164.

13120 GENERAL CONSIDERATIONS CONCERNING THE DESIGN OF ELECTRON GUNS. Sayegh, G.; Dumonte, P. (Sciaky, Vitry, France). pp A1-A19 of 2nd Electron Beam Processing Seminar. Silva, R. M. (ed.). Dayton, OH; Universal Technology Corp. (1972).

From second electron beam processing seminar; Frankfurt am Main, F. R. Germany (26 Jun 1972). See CONF-720696-.

Scientific methods used in the design of electron guns are briefly described. Information is included on functional parts of electron guns, electrostatic components, electromagnetic components, and relations between beam characteristics and weld geometries. (JRD)

13121 THEORY AND DEVELOPMENT OF ELECTRON BEAM HEAT SOURCES (GUNS FOR ELECTRON BEAM TECHNOLOGY). Schiller, S.; Heisig, U.; Lenk, P. (Forschungsinstitut Manfred von Ardenne, Dresden). pp 1b.1-1b.72 of 2nd Electron Beam Processing Seminar. Silva, R. M. (ed). Dayton, OH; Universal Technology Corp. (1972).

From second electron beam processing seminar; Frankfurt am Main, F. R. Germany (26 Jun 1972). See CONF-720696-.

Aspects of interactions of electron-optical components as applied in electron beam technology are examined. Information is included on electron emission, beam generating systems, beam guidance, and electron gun design. (JRD)

Corrosion and Erosion

Refer also to abstract 15103.

13122 (ANL-8042) INVESTIGATIONS OF MATERIAL COMPATIBILITY RELEVANT TO THE EBR-II SYSTEM: FY 1973. Ruther, W. E.; Greenberg, S. (Argonne National Lab., Ill. (USA)). Oct 1973. 32p. AT.

Owing to a low incidence of failure and replacement, only two items from the reactor plant were available for examination: piping from the secondary sodium system, and a thermocouple well from the fusible-seal trough. Both items showed negligible deterioration after nearly nine years in service. Two in-reactor experiments showed that: (a) chromium plating on stainless steel is completely compatible with flowing sodium at the highest temperature investigated, 845°F; and (b) inconsequential weight gains of ~0.1 mg/cm^2 resulted for specimens of Types 304, 304L, 316, and 316L stainless steels exposed to 986°F primary sodium flowing at 5 and 10 ft/sec. Concentrated sodium hydroxide solution within a crevice in stressed stainless steel did not cause cracking when the steel was inserted into 700°F sodium. Contamination of Types 304 and 316 (20% cold-worked) stainless steels with Rockwell 921 valve lubricant resulted in detectable carburization when the steel was held in 1018°F sodium for one week. Stem binding of NUPRO bellows-seal valves was traced to acceleration of oxidation of Type 440c steel by Molykote-G thread lubricant. A Cryofit tubing union failed quickly in a cycling test in 900°F sodium. A double O-ring joint with Parker No. 2 series silicone-rubber rings withstood sodium at 550 and 700°F long enough to allow for orderly shutdown of equipment. A thermal-expansion-difference (TED) passive temperature monitor for use in EBR-II was developed and standardized. Laboratory investigation of the problems resulting from sodium in the Bi-Sn eutectic alloy used in the rotating-plug fusible seal indicated that the sodium level should be maintained below ~200 ppM. Sodium can be removed from the alloy by heating the alloy in air. (auth)

13123 (BNWL-tr-92) SODIUM TECHNOLOGY. Chemical, Physical-Chemical, and Metallurgical Problems in the Sodium–Gas System of the Cover (Gas). Materials in Contact. Trouve, J.; Baque, P.; Champeix, L. Translated by E. R. Appleby from Bull. Inform. Sci. Tech. (Paris); No. 182, 61-69(1973). 21p. Dep. NTIS $3.25.

Sodium technology, concerning the chemical, physical-chemical, and metallurgical problems in the system sodium–cover gas–materials in contact, is necessary for the design of fast reactors. These properties influence the choice of materials and design at the project stage and the operation of the reactor. Studies of mass transfer in loops are made in simulation studies. An analysis of radioactive products in Rapsodie, an analysis of impurities in sodium, studies of transfer of radioactivity (transfer of ^{54}Mn in dynamic solution, and corrosion studies were made. Metallurgical and analytical procedures were discussed. (MCW)

13124 (CONF-730130-1) MOLYBDENUM IN NICKEL-BASE CORROSION-RESISTANT ALLOYS. Svistunova, T. V. (Climax Molybdenum Co., Greenwich, Conn. (USA)). 1971. 11p.

From symposium on new developments in the field of molybdenum-alloyed cast iron and steel; Moscow, USSR (17 Jan 1973).

Work on the corrosion resistance of alloys in the Ni–Mo system is reviewed. The phase diagram is related to the corrosion rate and ductility, and effects of other additives (C, Fe) and heat treatment are considered. (3 figures, 21 references) (DLC)

13125 (CONF-730133-1) CORROSION OF ZR ALLOYS. Tolksdorf, E. (Danish Atomic Energy Commission, Risoe. Research Establishment). Jan 1973. 9p. (In Danish). Dep. NTIS (U.S. Sales Only) $3.00.

From meeting on Danish Society for Metals; Middelfart, Denmark (8 Jan 1973).

The corrosion of Zr alloys in PWRs with hydrogen additions to the water is the same as without irradiation. The hydrogen uptake is 50% of the theoretical value. The oxygen concentration in BWRs greatly influences the corrosion of zirconium alloys. The corrosion rate under irradiation is much greater than in out-of-pile experiments. Models explain this as due to (1) the presence of free radicals as a result of γ radiation, (2) increased ion conduction in the oxide layer owing to radiation damage, and (3) a modification of the n-type oxide into a p-type. Oxygen diffusion in the p-type oxide is sensitive to the oxygen pressure in water. Corrosion in steam may be explained by the embrittlement of the oxide layer due to neutron irradiation. All models are preliminary, and none of them can take into consideration all the experimental observations. (DE)

13126 (DC-60-12-66) WATER VAPOR CORROSION OF UNCOATED BeO FUEL TUBES. Holowach, J.; Fincel, R. M. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). 6 Dec 1960. Contract AT(11-1)-171. 6p. Dep. NTIS $3.00.

Declassified 17 Sep 1973.

Three depleted BeO fuel tubes of 0.2-inch bore and 4.2 inches long were tested at 2500°F and 20 scfm of air with a 1.25% water vapor content to determine the effect of water vapor corrosion on the friction factor for periods of 4 to 8 hours. Pressure drop measurements before and after the test showed a maximum increase of 2.8% at a N_{Re} of 18,000. (auth)

13127 (LBL-888) AUGER ELECTRON SPECTROSCOPY ANALYSIS OF VANADIUM AND VANADIUM COMPOUND SURFACES. Szalkowski, F. J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1973. Contract W-7405-Eng-48. 256p. Dep. NTIS $15.00.

Thesis.

An ultra-high vacuum system containing a four grid Retarding Field Energy Analyzer was constructed and its supporting electronics developed to explore the feasibility of usefully measuring chemical shifts in the energy of Auger electrons using a combination LEED–AES type of apparatus. The availability of such chemical shift information is extremely important in determining the chemical composition of a thin surface layer since it would provide information on the state of chemical bonding of the atoms involved. LEED and AES studies were carried out on the (100) face of V metal. Characteristic-loss measurements were performed on V metal and V_2O_3 for the primary beam energy range of 100 eV to 700 eV. AES chemical shift studies were carried out on V_2O_4, V_2O_3, VO, VN, VC, V_2B_3, and VSi_2. (MCW)

13128 (N-73-27448) OXIDATION AT THROUGH-HOLE DEFECTS IN FUSED-SLURRY SILICIDE-COATED NIOBIUM ALLOYS FS-85 AND Cb-752. Levine, S. R. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Jul 1973. 35p. (NASA-TN-D-7324; E-7330). NTIS $3.00.

Metal recession and interstitial contamination at 0.08-centimeter-diameter through-hole intentional defects in fused-slurry silicide-coated FS-85 and Cb-752 niobium alloys were studied to determine the tolerance of these materials to coating defects. Five external pressure reentry simulation exposures to 1320°C and $4.7 \times 1{,}000$ N/m^2 (maximum pressure) resulted in a consumed metal zone having about twice the initial defect diameter for both alloys with an interstitial contamination zone extending about three to four initial defect diameters. Self-healing occurred in the 1.33×10 N/m^2, 1320°C exposures and to a lesser extent in internal pressure reentry cycles to 1320°C and 1.33×100 N/m^2 (maximum pressure). (STAR)

13129 (ORNL-tr-2700) INTERNAL OXIDATION OF METAL ALLOYS. Boehm, G.; Kahlweit, M. Translated from Acta Met.; 12: 641-648(1964). 16p. Dep. NTIS $3.00.

The oxidation is investigated with regard to the number of oxide particles precipitating per unit volume as a function of the experimental conditions and the distance from the phase boundary. The number of particles precipitating per unit volume with the transit of the oxidation front and its decrease with respect to the time under the influence of an immediately following redissolution are both calculated. Comparison with experiments on Ag–Cd alloys reveals good agreement between theory and experiment. (auth)

13130 (SLL-73-5300) EMBRITTLEMENT OF URANIUM AND U–0.8 Ti ALLOY BY HYDROGEN AND WATER. Johnson, H. R.; Dini, J. W.; Zehr, S. W. (Sandia Labs., Livermore, Calif. (USA)). Oct 1973. Contract AT(29-1)-789. 25p. Dep. NTIS $3.25.

Hydrogen can be introduced into uranium and uranium alloys from salt bath heating, from etching and electroplating, and from corrosion. Only a few parts per million of hydrogen picked up as a result of salt bath annealing severely reduces elongation. Minimum tensile properties are obtained in the range of 1 to 2 ppM hydrogen. In the case of etching and electroplating, any hydrogen pickup is concentrated at the surface and does not degrade tensile properties. Nickel plating noticeably reduces the corrosion of uranium and accompanying hydrogen generation. However, if the plating is thin (less than 0.012 mm), elongation and RA are noticeably reduced in the presence of water or water vapor presumably because of preferential corrosive attack at pinholes in the deposit. Ductility and tensile strength of uranium are dependent on the testing environment and decrease in the order: vacuum > air > water. The testing environment also has a strong influence on the properties of U–Ti alloy. Samples tested under varying conditions of moisture showed noticeable reductions in elongation and RA when compared with samples tested in vacuum. (auth)

13131 PHOTOEMISSION STUDIES OF THE OXIDATION OF Sr AND Ce. Helms, C. R. Stanford, CA; Stanford Univ. (1973). 221p. University Microfilms Order No. 73-30,409.

Thesis (Ph. D.).

Ultraviolet photoelectron spectroscopy (UPS), optical reflectance, and Auger electron spectroscopy (AES) were used to study the oxidation of Sr and Ce. The measurements include UPS quantum yield and UPS energy distribution curves Sr and Ce during oxidation at room temperature using photon energies up to 11.7 eV. Similar UPS experiments on Sr at 77 and 400°K also appear. Other measurements include normal incidence optical reflectivity of Sr during oxidation at room temperature and 400°K for photon energies up to 11.7 eV and second-derivative electron-induced Auger spectrum of Sr during oxidation at room temperature for energies below 1000 eV. (DLC)

13132 INFLUENCE OF FOREIGN IONS ON THE PROTECTIVE ACTION OF PHOSPHATES IN SEA WATER WITH RESPECT TO STEEL. Barannik, V. P.; Martinova, N. G. Dopov. Akad. Nauk Ukr. RSR, Ser. A; No. 9, 845-848(1973). (In Russian).

Corrosion protection of steel by some inorganic phosphates was studied in sea water with the presence of foreign ions. It is established that some ions (Cu^+, Cu^{2+}, Al^{3+}, Pb^{2+}, Sn^{2+}) influence the protective action of Na_2HPO_4 in sea water negatively, whereas others (Sr^{2+}, Cd^{2+}, MoO_4^{2-}, WO_4^{2-}) have a positive influence. Some other ions (Li^+, Mg^{2+}, Br^-, SO_4^{2-}) do not have any practical effect. The investigations were carried out in open experimental systems with free aeration and in closed ones without aeration. (auth)

13133 CORROSION-RESISTANCE TESTS UNDER LOAD ON STAINLESS AUSTENITIC STEELS IN CONTROLLED AQUEOUS MEDIUM. Mandru, G.; Munteanu, A.; Vasiliu, F.; Popescu, E.; Popescu-Pogrion, N. Rev. Chim. (Bucharest); 24: No. 8, 630-634(Aug 1973). (In Rumanian).

Results are presented concerning the corrosion behavior under load in aqueous media of some stainless austenitic steels of practical interest for the nuclear industry. The influences of carbon content and of the thermal sensitizing treatment on corrosion under load were studied, and it was found that, in the case of unstabilized and sensitized steels, the increase in carbon content augments the susceptibility to corrosive fissuring under load. The morphology and structure of the oxide film formed on tensioned samples is described. (auth)

13134 IMPROVEMENT IN OR RELATING TO METHOD AND APPARATUS FOR STORAGE OF HOLLOW ARTICLES. Farkasch, G. (to Nuclear Power Group Ltd.). British Patent 1,332,219. 3 Oct 1973. Filed date 28 Apr 1971. 4p.

A method is described for storing hollow articles, such as pipes, tanks, valves, pumps, etc. made of ferrous material, which are liable to corrosion by moist air. The interiors of the articles are evacuated to below atmospheric pressure and sealed. The pressure is preferably of the order of 3 to 10 psi below atmospheric, and the sealing means may consist of flange-lipped caps that include valve-sealed evacuating orifices. The sealing means may include a desiccating canister attached to its internal face, to absorb any moisture present within the article. (UK)

13135 STANDARD METHOD OF DETECTING SUSCEPTIBILITY TO INTERGRANULAR ATTACK IN WROUGHT NICKEL-RICH, CHROMIUM BEARING ALLOYS. 1973 Annual Book of ASTM Standards. Part 31. Philadelphia; American Society for Testing and Materials (1973). 6p. (ASTM-G-28-72).

The procedure for the boiling ferric sulfate–50% sulfuric acid test for measuring the susceptibility of certain nickel-rich, chromium-bearing alloys to intergranular attack is described. The boiling ferric sulfate–sulfuric acid test may be applied to the following alloys in the wrought condition: Hastelloy Alloy C, Hastelloy Alloy C-276, Hastelloy Alloy G, Carpenter Stainless

No. 20 Cb-3, Inconel Alloy 600, Inconel Alloy 625, Incoloy Alloy 800, and Incoloy Alloy 825. (auth)

13136 FORMATION KINETICS AND STRUCTURE OF SILICIDE COATINGS ON TANTALUM. Zmii, V. I.; Seryugina, A. S.; Kovtun, N. V. (Physical-Technical Inst., Kharkov). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 6, 848-851(Jun 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 6, 948-951(Jun 1973).

Diffusion in the system Ta-Si was investigated. The kinetic parameters determining the rate of growth of a $TaSi_2$ layer were calculated. They show that the chemical reactions at the interfaces control the process in the initial stage and have a marked effect on the equilibrium surface concentration and the rate of formation of the diffusion layer. (auth)

13137 INVESTIGATION OF THE CORROSION RESISTANCE OF SOME STRUCTURAL MATERIALS IN AN Al_2Cl_6 ENVIRONMENT. Zorin, N. F.; Kamenev, A. Ya. (Inst. of Nuclear Energy, Minsk). Vestsi Akad. Navuk Belarus. SSR, Ser. Fiz.-Energ. Navuk; No. 2, 121-126(1973). (In Russian).

Behavior of alloys based on Fe, Ni, Cu, Mo, W, Ta, some ceramics, glass, carbon, and other materials was investigated both in gaseous and liquid Al_2Cl_6 at 400, 500, 650, 750°C and 10 kg/cm^2 for 120, 360, and 1000 hours. It is shown that the ferrite and austenitic Fe-based alloys with Cr are unstable in Al_2Cl_6 at 650 and 750°C and that Ni-based alloys with Cr and Mo, W-based alloys have high stability but thin films of magnetic materials set down on their surfaces. Glass mica porcelain is not stable in Al_2Cl_6 but carbon has high stability. During tests, Al_2Cl_6 is polluted by great amounts of volatile products of Cr, Fe, Si, Ni, and others and its color is changed from light yellow to dirty violet. (auth)

Preparation and Fabrication

Refer also to abstracts 13066, 14834, and 15179.

13138 (CEA-CONF-2379) ADAPTATION OF A CONVENTIONAL EXTRUSION PRESS TO HYDROSTATIC OPERATION AND SOME EXAMPLES OF APPLICATION AT HIGH AND LOW TEMPERATURES. Decours, J.; Gavinet, J.; Segurens, L.; Weisz, M. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Div. de Metallurgie et d'Etude des Combustibles Nucleaires). 1973. 10p. (In English and French). (CONF-730670-2). Dep. NTIS (U. S. Sales Only) $3.00.

From international conference on hydrostatic extrusion; Stirling, Scotland, UK (13 Jun 1973).

A description is presented of the technique used to transform a conventional vertical extrusion press for operation under hydrostatic pressures up to 13,000 bars. This is obtained by means of a mobile seal located at the rear part of the container. Hydrostatic extrusion can be performed up to 1200°C provided the proper lubricant is used. Examples of different types of extruded products are presented. They are either in the form of bars, tubes or sections and include cold extrusion of light alloys such as aluminum and magnesium; warm extrusion of copper-base alloys and zirconium alloys (e.g., zircaloy 4); and hot extrusion of stainless steels and nickel-base alloys. The plastic flow and the thermal exchanges are very complex. Some of the problems which have been encountered in developing and applying this technique are emphasized. (auth)

13139 (FRNC-TH-409) PREPARATION OF Be CRYSTALS HAVING ONLY VERY SLIGHT DISORIENTATIONS. Faure-Deloche, J. (Grenoble-1 Univ., 38 (France)). 1973. 79p. (In French). Dep. NTIS (U. S. Sales Only) $6.00.

Thesis.

An attempt was made to eliminate crystal disorientation existing in crystals of Be obtained by the Czochralski method. The crystals could then be used in neutron monochromators. The failure of the Czochralski method to provide satisfactory results with Be crystals led to work on Be-Cu alloys diluted in Cu and to the establishment of part of the phase diagram of the bcc system. In addition, the existence of preferential growth directions led to studies being effected on the allotropic transformation of Be; the poor quality of the crude crystals obtained by the method was attributed to this transformation. In order to determine the nature of the crystal defects, a thermal relaxation method was developed for establishing the existence of boundary displacements of at least 10 minutes of arc between two different parts of the crystal. An attempt was then made to improve the quality of Be crystals by heat treatment. Using this method, less than 4 minutes of disorientation was obtained throughout the bulk of a 1-cm^3 crystal originally having disorientations of several degrees. (28 figures, 42 references) (FR)

13140 (GEPP-117) PURIFICATION OF RARE EARTH METALS. DeMarco, G. W. (General Electric Co., St. Petersburg, Fla. (USA). Neutron Devices Dept.). 10 Dec 1973. Contract AT(29-2)-656. 9p. Dep. NTIS $3.00.

Experimental work at the Neutron Devices Department requires ultrahigh-purity rare earth metals not available from commercial sources. A process of vacuum distillation/sublimation that increases the purity of most metals is reported. Results are given for purification of scandium, thulium, yttrium, and erbium. Major impurities were found to be tungsten or tantalum and dissolved gases such as a fluorine, oxygen, nitrogen, and hydrogen. In general, the process is capable of increasing the purity of most material as long as the vapor pressures of the impurities are significantly higher or lower than the vapor pressure of the material to be purified. (auth)

13141 (HW-64553) METALLOGRAPHIC CHARACTERIZATION OF THE INTERFACES OF URANIUM: ZIRCALOY-2 IN COEXTRUDED NUCLEAR FUEL ELEMENTS. Guay, A. E.; Nickolaus, J. W.; Goffard, J. W.; Hartcorn, L. A. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 19 Apr 1960. 17p. Dep. NTIS $3.00.

Declassified 8 Jan 1973.

The interface was evaluated in relation to the coextrusion process variables, β heat treatment, secondary working, and end-closure welding. The evaluation included interface cleanliness, bond peel tests, and corrosion tests of defected samples. Impurities in the interfaces are attributed to improper cleaning of U. (DLC)

13142 (HW-70852) COEXTRUSION PROCESS FOR N-FUEL COMPONENTS AND EVALUATION OF PRODUCT PROPERTIES VERSUS INPUT MATERIALS AND PROCESS VARIABLES. Shaw, C. H. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 30 Aug 1961. Contract AT(45-1)-1350. 46p. Dep. NTIS $4.50.

Declassified 8 Jan 1973.

Coextrusion of Zircaloy-2-clad U tubing was modified to produce the fuel geometries required by NPR. The billet components and extrusion process are described, and characteristics of the coextruded tubing and test results are given. (31 figures) (DLC)

13143 (HW-79582) URANIUM SURFACE ELECTROCHEMISTRY AND NICKEL ELECTROPLATING INTERIM REPORT. Braun, R. L.; Stromatt, R. W. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). Nov 1963. Contract AT(45-1)-1350. 26p. Dep. NTIS $3.50.

Declassified 19 Feb 1971.

An electrochemical technique, measuring the uranium potential in $NaClO_4$ solution versus a reference electrode, was developed to characterize the uranium surface resulting from a given surface preparation before the electrodeposition of nickel. This technique has enabled the investigation of such variables as exposure time, solution temperature, and HNO_3 concentration in the pickling step following an H_3PO_4-HCl anodic etch. It has also enabled evaluation of other pretreatments in terms of the active or passive condition of the uranium surface. Various plating baths and uranium surface preparations were evaluated through examination of the gas pitting, adherence, and porosity of nickel-plated uranium specimens. These plating results were correlated with the potential measurements to further substantiate the validity of using these measurements in the $NaClO_4$ solution to determine the suitability of a uranium surface for an adherent nickel electroplate. (auth)

13144 (UCRL-75121) INTERRELATIONSHIPS BETWEEN PROCESS PARAMETERS, STRUCTURE, AND PROPERTIES OF CVD TUNGSTEN AND TUNGSTEN-RHENIUM ALLOYS. Holman, W. R.; Huegel, F. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 Dec 1973. 22p. (CONF-740103-1). Dep. NTIS $3.25.

From conference on structure-property relationships in thick film and bulk coatings; San Francisco, California, USA (28 Jan 1974).

The development of CVD techniques for fabricating free-standing tungsten and tungsten-rhenium alloy structures is reviewed. Relationships between plating parameters, kinetics, morphology, microstructure, and properties of thick polycrystalline deposits are discussed. It is emphasized that porosity may be grown into the grain boundaries when the deposition rate is controlled by gas phase diffusion, and that fully dense deposits are generally obtained when the rate is limited by a surface process. The origin and control of many of the microstructural features peculiar to CVD are also discussed. (11 figures) (auth)

13145 ANNEALING KINETICS OF Pu-1 WT % Ga. Rafalski, A. L. (Dow Chemical Co., Golden, CO). J. Nucl. Mater.; 49: No. 1, 75-80(Nov 1973).

The annealing kinetics of high-purity Pu–1 wt % Ga, cold-worked 30 to 90% by rolling, was studied at 275°C. The softening behavior was influenced by the amount of prior deformation because recovery decreased as the amount of deformation increased. The recrystallization behavior after 75% deformation was investigated over the temperature range 255 to 300°C. Analysis indicated that the rate of recrystallization in Pu–1 wt % Ga was controlled entirely by grain growth. (7 figures) (auth)

13146 TRACING THE ORIGIN OF NONMETALLIC INCLUSIONS IN STEEL BY GAMMA SPECTROMETRY. Hons, J. (Vyzkumny Ustav Hornictvi Zeleza, Trinec, Czech.). Hutn. Listy; 28: No. 3, 225-227(Mar 1973). (In Czech).

The transfer of refractory materials from the tapping hole and running channel into molten steel to form inclusions and into the slag was determined by a method based on labeling. Rare earth oxides were added to the refractory material and detected in the steel and slag by neutron-activation analysis. Both a mixture of La, Ce, Nd, or Pr with Sm oxides and pure La_2O_3 were used. The steel or the slag samples were then irradiated in a neutron flux of 1×10^{13} n/cm^2 for 2 to 5 minutes, and the concentration of the isotopes was determined by a 1000-channel gamma spectrometer with semiconductor detectors. With La, 330-, 490-, and 810-keV energies were used. It was found that 1.06% of the weight of the refractory lining in the running channel passed into the steel as nonmetallic impurities; this was 3.17% of the total content of inclusions in the metal resulting from the operation. The content of La in the steel increased linearly with the content of the inclusions. The behavior of La_2O_3 during the whole process was proved to be identical with the behavior and motion of nonmetallic inclusions. (INIS)

13147 IMPROVEMENTS RELATING TO SPUTTERING. Jackson, G. N. (to Electrical Research Association). British Patent 1,332,791. 3 Oct 1973. Filed date 6 Mar 1970. 8p.

The method described has the object of increasing the uniformity of deposition of sputtered coatings by the use of appropriately shaped electrodes or by variation of electrode spacings with regard to the substrate. A radiofrequency supply source is used, connected to a pair of similar electrodes mounted side by side in an evacuated sputtering chamber, the sputtering constituting one stage of an in-line process in which the substrate is moved through successive evacuated chambers. The electrode systems decrease progressively in width from the edges of the substrate to the center at a rate chosen so as to compensate for variations in coating thickness that would otherwise occur. The electrodes may also be shaped so that the spacing between them and the substrate decreases towards the edges, for the same reason. The electrodes may also be flat and the substrate shaped so that the spacing between it and the electrodes decreases towards the edges, again for the same reason. (UK)

13148 GRAIN-REFINING EFFECT OF BORON IN CARBON STEEL WELDS. Devletian, J. H. (Youngstown State Univ., OH); Heine, R. W. Weld. J. (N.Y.); 52: No. 12, 529s-535s(Dec 1973).

Boron in amounts greater than 0.0006% was found to have a powerful grain-refining effect on the microstructure of carbon steel welds, as deposited by the gas tungsten-arc (GTA) and gas metal-arc (GMA) welding processes. The factors contributing to grain refinement and the mechanism by which it occurred were investigated. Boron's influence upon the solidification mode of plain carbon steel weld metal was found to be negligible primarily because so little boron (0.001% to 0.003% B) is used to alloy steels. However, boron was instrumental in refining the grain size of as-deposited steel weld metal by promoting the nucleation of blocky ferrite at Mn-segregated cell boundaries during the transformation from austenite. Because each columnar austenite grain contained a fine cellular solidification substructure, boron's ability to cause the nucleation of blocky ferrite at cell boundaries resulted in considerable refinement of the as-welded grain size and a decrease in hardenability (associated with a small austenite grain size). Boron's grain-refining effect was found to be contingent upon five major variables: (a) boron, (b) carbon, (c) Mn content, (d) weld cooling rate, and (e) the welding process used. If a carbon steel contained at least 0.5% Mn, 0.18% C (min) and 0.0006% B (min), grain refinement of as-deposited GMA and GTA welds was assured provided that the weld cooling rates were neither excessively fast (all martensitic structure) nor extremely slow where the structure would be heavily ferritic. (auth)

13149 COBALT-BASE SURFACING OF INCONEL 718. Douty, R. A.; Schwartzbart, H. (Rockwell International Corp., Pittsburgh). Weld. J. (N.Y.); 52: No. 12, 550s-556s(Dec 1973).

The properties of Inconel 718 suggest its use as a material of construction in the liquid sodium cooled fast breeder reactor. In some of its uses it would be desirable that it be surfaced for hardness with a cobalt base alloy. Because of prior observations of microfissuring in the welding of Inconel 718, a study was completed to determine whether this phenomenon would be encountered in transferred arc plasma surfacing, and, if so, the influence of various metallurgical and process parameters on its occurrence. Six-inch rounds of Inconel 718 from different heats and sources were surfaced with CoCrA by the transferred arc plasma process. The variables studied were 718 processing history, composition, grain size, and heat input during surfacing. A prior researcher had proposed the use of fillerless gas tungsten-arc welding (GTAW) to indicate the susceptibility of Inconel 718 to microfissuring. Therefore, this possibility was studied. Of the variables studied, only the grain size of the Inconel 718 appeared to have any significant and systematic effect on microfissuring behavior. Coarse-grained material was more prone to cracking than fine-grained material. All of the cracking occurred under the deposit, confined entirely to the grain boundaries in the heat-affected zone of the base metal. None of the fillerless gas tungsten-arc welds exhibited any cracking. Therefore, GTAW did not serve as an indicator of cracking susceptibility. (auth)

13150 EFFECT OF FURNACE ATMOSPHERE ON HEAT-TREAT CRACKING OF RENE 41 WELDMENTS. D'Annessa, A. T.; Owens, J. S. (Lockheed-Georgia Co., Marietta, GA). Weld. J. (N.Y.); 52: No. 12, 568s-575s(Dec 1973).

Cracking in Rene'41 weldments is evaluated. Results of metallographic and acoustic-emission analyses are included. It is noted that the exclusion of oxygen from the heat-treating environment does not eliminate postweld cracking of Rene' 41. Vacuum heat treating, as contrasted with heating of air, has a beneficial effect comparable to that obtained by simply lowering the weld energy input. Use of a vacuum environment slightly increases the on-heating temperature at which gross cracking occurs; this increase was similar to that achieved with weldments produced by lower weld energy input techniques. The primary benefit obtained by the exclusion of oxygen is an increase in the resistance to gross crack extension. Acoustic emission analyses revealed that the mode of cracking shifts from predominately rapid (unstable) crack growth in air to less rapid (stable) crack extension in vacuum. Consequently, the use of vacuum for heat treating might prove useful for components in which the restraint stresses are near "threshold" value; that is, where restraint conditions are just sufficient to create some or intermittent cracking difficulties when heat treating in air. An increased resistance to crack propagation with vacuum heat treatment was also revealed by replica and scanning electron microscopy; microplasticity features were more prevalent in the fractures of specimens heat treated in vacuum than they were on air atmosphere test fractures. As an approach to avoiding heat treat cracking, the exclusion of oxygen from the furnace atmosphere would be useful in any general fracture control plan. Except under marginal restraint conditions, the use of an oxygen-free furnace atmosphere is not, in itself, sufficient for eliminating postweld heat treat cracking. (auth)

13151 PROCESS OF MAKING HIGH-STRENGTH, HIGH-DENSITY, HIGHLY DUCTILE URANIUM–TITANIUM ALLOY. Edelman, R. E.; Saia, A. (to Secretary of the Army). US Patent 3,773,569. 20 Nov 1973. Filed date 1 Oct 1971. 4p.

Furnace tempering of a solution treated, water-quenched, worked cast ingot at 600°F for about 4 hours in an inert atmosphere and permitting furnace cooling yields a uranium–1.25 titanium alloy having the following physical properties: tensile strength: 234,700 psi, yield strength: 172,700 psi, elongation in 1 inch: 17%, and nominal density: 18.5g/cc. (Official Gazette)

13152 LOW-CYCLE FATIGUE OF COLD-PRESS-WELDED ZIRCONIUM. Rie, K. T.; Ruge, J. (Technische Univ., Brunswick). Schweissen Schneiden; 25: No. 6, 203-204(1973). (In German).

The behavior of cold-press welding as regards low-cycle fatigue on zirconium–zirconium joints was examined. Alternating torsion tests were carried out with constant strain amplitudes at room temperature on butt-welded and nonwelded zirconium samples (reactor-grade, annealed). During the tests, the torsional moment and the change in sample length were continually recorded. The lifetime until rupture and the critical lifetime could be determined from the alternating flow curves. In the case of stresses leading to low-cycle fatigue, the rupture always occurs outside the welding seam. The cold-press welding joint on zirconium proved to be secure and showed no decrease of the critical load cycle. (GE)

13153 PREPARATION OF Nb_3Sn COATINGS FROM THE GAS PHASE. Petrusevich, I. V.; Kozlov, F. N.; Bogdanov, V. P.; Nisel'son, L. A. Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 6, 852-854(Jun 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 6, 952-955(Jun 1973).

Preparation of Nb_3Sn coatings by hydrogen reduction of $NbCl_5$ and $SnCl_4$ was investigated using a reaction chamber incorporating a hot moving Ni–Mo alloy tape. The dependence of the coating thickness on the speed of the moving tape, the hydrogen concentration, and the speed of the gas current during coreduction of higher Nb and Sn chlorides by hydrogen were determined. The uniformity of composition and the structure of the Nb_3Sn coating over the length of the tape were also determined. The temperature of transition of the coating to the superconducting state was 17.7°K. (auth)

13154 FORMATION OF METASTABLE CARBIDE PHASE WITH FACE CENTERED SUBLATTICE OF METAL ATOMS IN THE DECOMPOSITION OF TUNGSTEN CARABONYL. Toryanik, V. V.; Krylov, V. D.; Umanskii, Ya. S. (Moscow Inst. of Steel and Alloys). Dokl. Akad. Nauk SSSR; 212: No. 1, 86-87(1 Sep 1973). (In Russian).

X-ray examination of powder samples obtained by thermal decomposition of $W(CO)_6$ showed that tungsten carbide with a face-centered lattice phase is formed at 400 to 600°C. At 700°C and higher, pure tungsten is formed also. Lattice constants are tabulated for temperatures from 400 to 800°C. (TTT)

13155 PRINCIPLES OF ELECTRON BEAM TECHNOLOGY. Smith, H. R. Jr. (Airco Temescal, Berkeley, CA). pp 1a.1-1a.66 of 2nd Electron Beam Processing Seminar. Silva, R. M. (ed.). Dayton, OH; Universal Technology Corp. (1972).

From second electron beam processing seminar; Frankfurt am Main, F. R. Germany (26 Jun 1972). See CONF-720696-.

Principles associated with generation and manipulation of electron beams are reviewed along with aspects of vacuum technology and materials technology. Information is included on the history and present status of electron beam technology. It is noted that new applications are expected in component coating processes, annealing processes, and for high vacuum formation of organic polymers. (JRD)

13156 ECONOMICS OF ELECTRON BEAM MELTING, WELDING, AND COATING PROCESSES. Dietrich, W. (Leybold-Heraeus GmbH and Co., Hanau, Ger.). pp 1c.1-1c.20 of 2nd Electron Beam Processing Seminar. Silva, R. M. (ed.). Dayton, OH; Universal Technology Corp. (1972).

From second electron beam processing seminar; Frankfurt am Main, F. R. Germany (26 Jun 1972). See CONF-720696-.

Processes involved with electron beam melting of refractory metals are discussed. Information is included on electron beam furnaces, production costs for Ta ingots, Ti ingot production costs, energy requirements for steel strip coating, cost of Al deposition on steel strip, and electron beam tube welding. (JRD)

13157 PRODUCTION AND METALLURGY OF REFRACTORY AND REACTIVE METALS. Krueger, J. (Lurgi Chemie und Heuttentechnik GmbH, Frankfurt am Main). pp 2b.1-2b.29 of 2nd Electron Beam Processing Seminar. Silva, R. M. (ed.). Dayton, OH; Universal Technology Corp. (1972).

From second electron beam processing seminar; Frankfurt am Main, F. R. Germany (26 Jun 1972). See CONF-720696-.

The advantages of refractory-metal melting by electron beams are noted. Discussions are also included on the effects of melting rate on properties of liquid refractory metals, carbon–oxygen reactions in refractory metals, removal of gases from these metals, degassing rates, and electron beam refining of metals. Data and information are included on refining of specific refractory metals such as V, Nb, Ta, Mo, Th, W, and Ti. (20 figures, 27 references) (JRD)

13158 INVESTMENT CASTING OF REFRACTORY METALS. Mueller, C. P.; Koon, J. F. (Rem Metals Corp., Albany, OR). pp 2d.1-2d.102 of 2nd Electron Beam Processing Seminar. Silva, R. M. (ed.). Dayton, OH; Universal Technology Corp. (1972).

From second electron beam processing seminar; Frankfurt am Main, F. R. Germany (26 Jun 1972). See CONF-720696-.

Investment casting processes are reviewed. Discussions are included on mold systems for reactive and refractory metal investment casting, preparation of melt stock, casting production processes, nondestructive testing, mechanical properties of castings, design of investment molds, and potential uses. (33 figures, 16 tables, 23 references) (JRD)

13159 PRINCIPLES OF ELECTRON BEAM WELDING. Schultz, H. (IABG, Munich). pp 3a.1-3a.48 of 2nd Electron Beam Processing Seminar. Silva, R. M. (ed.). Dayton, OH; Universal Technology Corp. (1972).

From second electron beam processing seminar; Frankfurt am Main, F. R. Germany (26 Jun 1972). See CONF-720696-.

The present status of electron-beam welding is reviewed. Comparisons of electron beam welding with laser and plasma welding are included. Information is also included on fundamentals of electron-beam welding, fundamental processes of laser and plasma welding, effects of acceleration voltage and vacuum pressure variations, welding parameters, and metallurgical aspects. (16 figures, 17 references) (JRD)

13160 AUTOMATION AND MASS PRODUCTION. Fritz, D.; Luxemburger, R. (Leybold-Heraeus GmbH and Co., Hanau, Ger.). pp 3d.1-3d.35 of 2nd Electron Beam Processing Seminar. Silva, R. M. (ed.). Dayton, OH; Universal Technology Corp. (1972).

From second electron beam processing seminar; Frankfurt am Main, F. R. Germany (26 Jun 1972). See CONF-720696-.

Mass-production welding using automated electron-beam welding machines is discussed. Information and data are included on automatic partial vacuum machines nonvacuum welders, continuous welding equipment, and automated machines incorporating lock chambers. (JRD)

13161 ELECTRON BEAM MACHINING. Schleich, F. (Zeiss, Oberkochen, Ger.). pp 3f.1-3f.85 of 2nd Electron Beam Processing Seminar. Silva, R. M. (ed.). Dayton, OH; Universal Technology Corp. (1972).

From second electron beam processing seminar; Frankfurt am Main, F. R. Germany (26 Jun 1972). See CONF-720696-.

The history of electron-beam machining is reviewed followed by discussions of removal processes in electron-beam machining. Information is included on removal-process models, electron-optics, requirements, beam control in automatic equipment, precision machining, applications, and cost. (54 figures, 20 references) (JRD)

13162 HARDENING AND REFINING SURFACE TREATMENT OF METALS BY HIGH-VOLTAGE ELECTRON BEAM. Hiller, W. (Steigerwald-Krauss-Mafei GmbH, Munich). pp 3g.1-3g.32 of 2nd Electron Beam Processing Seminar. Silva, R. M. (ed.). Dayton, OH; Universal Technology Corp. (1972).

From second electron beam processing seminar; Frankfurt am Main, F. R. Germany (26 Jun 1972). See CONF-720696-.

Electron-beam technology research directed toward better material performance by reducing the gap between theoretical and test strength and by minimizing the difference between nominal and actual composition is reviewed. Electron-beam technology offers new ways also for the thermal treatment of metallic materials. Due to the peculiar physical characteristics of such treatment, unexpected materials properties can be revealed. Local remelting by the electron beam results in markedly improved strength properties and homogeneity of the material. Electron-beam hardening is to be considered as a precision-hardening method which yields exceptional hardness figures. As to metallurgy, the extremely fast thermal cycles involved by the electron beam processes entail a lot of questions about such matters as the nonequilibrium constitution of alloys upon rapid solidification, the time–temperature–transformation phenomena upon quick heating, and the nature of unusually high hardness values. Results obtained in practice with electron-beam-treatment processes are encouraging. Further progress will essentially depend on a successful coordination of electron beam technology, metallurgy, and process engineering. (JRD)

13163 APPLICATION OF EB COATING IN THE METALS AND GLASS INDUSTRIES. Part I. The Metals Industry. Sommerkamp, P. (Leybold-Heraeus GmbH and Co., Hanau, Ger.). pp 4b.1-4b.71 of 2nd Electron Beam Processing Seminar. Silva, R. M. (ed.). Dayton, OH; Universal Technology Corp. (1972).

From second electron beam processing seminar; Frankfurt am Main, F. R. Germany (26 Jun 1972). See CONF-720696-.

The development of electron-beam coating processes is reviewed. Information is included on pilot plants in operation, equipment for vacuum processing of steel strip, properties of electron-beam coatings, electron source requirements, coating processes for Al, and future developments. (JRD)

13164 COATINGS IN THE OPTICS AND ELECTRONICS INDUSTRIES. Willmanns, J. (Leybold-Heraeus GmbH and Co., Hanau, Ger.). pp 4c.1-4c.20 of 2nd Electron Beam Processing Seminar. Silva, R. M. (ed.). Dayton, OH; Universal Technology Corp. (1972).

From second electron beam processing seminar; Frankfurt am Main, F. R. Germany (26 Jun 1972). See CONF-720696-.

The importance of electron-beam techniques for coatings in electronic and optical applications is great. The applications range from the fabrication of coatings of refractory materials, which cannot be evaporated by joule heating, to the most ordinary coatings. In all these cases one of the benefits is the high rate that can be realized and that may lead to higher throughput and better utilization of the vacuum plant. Electron-beam guns permit the fabrication of alloys of arbitrary composition which, once fixed, can be maintained for production. Mixtures of ceramics

and metals result in cermet elements of exceptional electrical and mechanical quality. Mixtures of different dielectric and metallic compounds permit the fabrication of optically effective layers which cannot (practically) be obtained under similarly advantageous conditions by any other method. On a still finer scale, the same electron beam which serves for production may enhance the quality of the finished product by preparing the substrates and be used to investigate the results in a scanning electron microscope, for example. It may even be used for trimming of resistive elements on a microscale. (auth)

Properties, Structure, and Phase Studies

Refer also to abstracts 13069, 13102, 13114, 15112, 15114, 15128, 15139, 15141, 15142, 15180, and 15195.

13165 (ANL-7996, pp 92-97) HIGH-TEMPERATURE CHEMISTRY. Thorn, R. J.; Ackermann, R. J.; McCreary, J. R.; Rauh, E. G.; Winslow, G. H. Feb 1973.

In chemistry division annual report, July 1971–June 1972.

Studies on phase equilibria and thermochemical measurements are summarized. Melting points, eutectic temperatures, and solubilities were measured for binary and ternary metallic systems including U–W, U–Ta, Th–W, Th–Ta, U–Th–W, Hf–W, and Zr–W. New methods requiring only a few hundred milligrams of metal were devised. The vapor pressures and enthalpies of vaporization of liquid Th, solid and liquid Hf, and liquid Zr were determined over the temperature range 1040 to 2550°K by mass-effusion and mass-spectrometric techniques. The free energies, enthalpies, and entropies of formation of some refractory metals and their oxides, including Y, YO, Hf, HfO, Th, ThO, Zr, and ZrO, are tabulated. Thermodynamic data on GdF_3 were used in studies on the correlation of enthalpy and entropy and the variation of errors with enthalpy and entropy. Studies on thermochemical systematics are being continued. (JGB)

13166 (ANL/EBR-77) ANALYSIS OF THE LEAK-DETECTION SYSTEM FOR TOP WELDS OF EBR-II FUEL ELEMENTS. Hudman, G. D.; Walters, L. C. (Argonne National Lab., Ill. (USA); Argonne National Lab., Idaho Falls, Idaho (USA)). May 1973. Contract W-31-109-Eng-38. 31p. Dep. NTIS $3.75.

An analysis of the leak detector used to check the top welds on EBR-II fuel elements was performed. Data were obtained to allow calculation of volumes of the metering chamber and test chamber at each station of the leak detector. These volumes and a mathematical model were used to calculate decrease in pressure with time for each station. Values for calibrated leaks and unknown leak rates were compared with calculated ones. The calculated results for the two calibrated leaks agreed with the observed pressure–time results for the two leaks. Results show that determining the volumes of each leak-detector station allows the leak-rate sensitivity to be readily calculated for each station. One leak-detector station could not detect a minimum leak rate of 2×10^{-4} std cm³/sec at 40 atm, which is the current specification. The other four stations could meet the specification. Suggestions are given for periodic calibration of the leak detectors as well as precautions that must be observed to achieve optimum sensitivity when operating the leak detector. (auth)

13167 (CONF-731114-30) EROSION OF STAINLESS STEEL FIRST WALL BY HELIUM BLISTERING. Das, S. K.; Kaminsky, M. (Argonne National Lab., Ill. (USA)). 1973. 7p. Dep. NTIS $3.00.

From 5th symposium on engineering problems of fusion research; Princeton, New Jersey, USA (6 Nov 1973).

The blister formation and the erosion rates associated with helium blistering in annealed 304 stainless steel were investigated for helium projectiles with energies ranging from 100 keV to 1.5 MeV and for irradiation temperatures ranging from room temperature to 550°C. The total dose was varied from 0.1 C/cm² to 1.0 C/cm². The results show that the blister size increases with increasing projectile energy. The degree of blistering, and the erosion rates associated with blister rupture and exfoliation are found to be strongly temperature dependent. Maximum erosion rates were observed at irradiation temperature of around ~450°C. The erosion rates decreased at higher temperature ~650°C. The degree of blistering is found to increase with increasing dose. (auth)

13168 (COO-1198-1024) PRESSURE DEPENDENCE OF THE THERMOELECTRIC POWER OF SODIUM BETWEEN 5°K AND 14°K. Weiss, J. D. (Illinois Univ., Urbana (USA)). Feb 1974. Contract AT(11-1)-1198. 103p. Dep. NTIS $7.25.

The effect of pressure was measured on the thermoelectric power of sodium between 5 and 14°K where phonon drag is believed to play a prominent role. A superconducting quantum interference device ("SQUID") was used to measure the tiny voltages involved. At 1 and 2 kilobars no effect was observable, but at 3 kilobars the thermoelectric power was observed to grow smaller in magnitude, but remained negative. The effect of pressure was most noticeable above 11°K and was monotonically increasing with temperature above that point. The results are compared with the predictions of a theory of phonon drag thermoelectric power by Bailyn, which are in rather good qualitative agreement with the data. The results of this experiment therefore support his contention that a detailed understanding of the lattice spectrum, rather than Fermi-surface distortion, is necessary to understand the role of phonon drag in the alkali metals. (auth)

13169 (COO-3027-11) HIGH-TEMPERATURE VAPOR PRESSURE AND THE CRITICAL POINT OF POTASSIUM. Jerez, W. R.; Bonilla, C. F. (Columbia Univ., New York (USA)). 1972. Contract AT(11-1)-3027. 112p. Dep. NTIS $7.75.

Thesis. Submitted by W. R. Jerez.

The vapor pressure was determined from 1600°F up to the critical point. The equation $\ln P = A + B/T + C \ln T$ was found to fit the data well, a fourth term D/T^2 further improved the fit. A novel design was employed in measuring the vapor pressure, which provides a direct determination of the critical pressure, because at all tip temperatures higher than the critical temperature the same "breakoff pressure" is observed. This "breakoff" pressure", which is produced when the liquid level reaches the critical temperature in its travel along the bore of the tube, is the critical pressure. (58 figures, 50 references) (DLC)

13170 (N-73-31498) MECHANICAL-PROPERTY DETERMINATION OF HIGH-CONDUCTIVITY METALS AND ALLOYS. Final Report. Harrod, D. L.; VanDergrift, E.; France, L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Feb 1973. Contract NAS7-725. 158p. (NASA-CR-133890; WANL-M-FR-72-5). NTIS $10.00.

Pertinent mechanical properties of three high conductivity metals and alloys; namely, vacuum-hot-pressed grade S-200E beryllium, OFHC copper, and beryllium–copper alloy no. 10 were determined. These materials were selected based on their possible use in rocket thrust chamber and nozzle hardware. They were procured in a form and condition similar to that which might be ordered for actual hardware fabrication. The mechanical properties measured include (1) tension and compression stress strain curves at constant strain rate (2) tensile and compressive creep. (3) tensile and compressive stress-relaxation behavior, and (4) elastic properties. Tests were conducted over the temperature range of from 75 to 1600°F. Data is presented in both graphical and tabular form. (auth)

13171 (ORNL-tr-2731) ELECTROPOLISHING OF NIOBIUM IN METHANOL SOLUTION. Sorajic, V. Translated by M. Gerrard from Metalloberflaeche- Angew. Elektrochem.; 27: No. 5, 80-82 (1973). 4p. Dep. NTIS $3.00.

Niobium can be anodically polished in a 1 M $Mg(ClO_4)_2$ solution at a temperature below –10°C. This medium shows various advantages over the conventional HF-containing polishing solutions. From current density–potential curves, the optimum polishing conditions (in a stationary electrolyte) were determined to be 5.5 to 8 V at –20°C and 6 to 9 V at –30°C (Ag/AgCl reference electrode). (auth)

13172 (RDT-M-5-8-T(1-74)) NICKEL–MOLYBDENUM–CHROMIUM ALLOY SHEET AND PLATE (ASME SB-434 WITH ADDITIONAL REQUIREMENTS). (USAEC Division of Reactor Research and Development, Washington, D. C.). Jan 1974. 8p. RSO.

A standard prescribing requirements for nickel–molybdenum–chromium alloy sheet and plate (ASME SB-434 with additional requirements for nuclear and associated applications is presented. This standard supersedes RDTM 5-8T, dated January 1972. (JRD)

13173 (RDT-M-7-6-T(1-74)) PRECIPITATION-HARDENING STAINLESS STEEL BARS, SHAPES, AND FORGINGS (ASME SA-564 WITH ADDITIONAL REQUIREMENTS). (USAEC Division of Reactor Research and Development, Washington, D. C.). Jan 1974. 10p. RSO.

A standard prescribing requirements for precipitation-hardening stainless steel bars, shapes, and forgings (ASME SA-564 with additional requirements for nuclear and associated applications is presented. This standard supersedes RDTM 7-6T, dated May 1973. (JRD)

13174 (RDT-M-7-10-T(11-73)) NICKEL–IRON–CHROMIUM ALLOY ROD AND BAR (ASME SB-408 WITH ADDITIONAL REQUIREMENTS). USAEC Division of Reactor Research and Development, Washington, D. C.). Nov 1973. 7p. RSO.

A standard prescribing requirements for nickel–iron–chromium alloy rod and bar (ASME SB-408 with additional requirements) for

nuclear and associated applications is presented. This standard supersedes RDT M 7-10T dated July 1971. (JRD)

13175 (RLO-2225-T-13-20) INFLUENCE OF CONSTITUTION AND MICROSTRUCTURE ON THE TEMPERATURE COEFFICIENT OF RESISTIVITY IN Ti-BASE ALLOYS. Chandrasekaran, V.; Taggart, R.; Polonis, D. H. (Washington Univ., Seattle (USA). Div. of Metallurgical Engineering). 1973. 23p. Dep. NTIS $3.25.

Previous investigations have attributed the negative value of $d\rho/dT$ in the metastable beta phase to the formation of a reversible athermal omega phase. The present investigation shows that the negative value of $d\rho/dT$ in beta-stabilized Ti alloys (Ti–Cr) is a singular property of the beta phase and is independent of the reversible athermal omega transformation. Variations in the value of $d\rho/dT$ due to solute concentration, modifications in constitution and microstructure, and plastic deformation were also examined. (auth)

13176 I. STUDY OF VACANCIES IN QUENCHED TUNGSTEN. II. DESIGN AND CONSTRUCTION OF A FIELD ION MICROSCOPE SYSTEM WITH A MULTIPLE SAMPLE CAPABILITY. Khoshnevisan, M. East Lansing, MI; Michigan State Univ. (1973). 140p. University Microfilms Order No. 73-29,725.

Thesis (Ph. D.).

The dependence of quenched-in resistances on quench temperature and quenching speed was studied for fine wires of very pure W quenched under superfluid helium and in an ultrahigh ($p < 1.5 \times 10^{-9}$ torr) vacuum. The vacuum quenches yielded results substantially the same as those obtained for superfluid helium quenches. These resistances are ascribed to vacancies trapped in the samples by the rapid quench. Extrapolation to infinite quench speed produced a vacancy formation energy larger than the value of 3.3 eV proposed by Schultz. Analysis in terms of the theory of Flynn, Bass, and Lazarus yielded a vacancy formation energy of 3.6 ± 0.2 eV and a vacancy motion energy of 2.5 ± 0.5 eV, assuming an activation energy for self-diffusion of 6.1 ± 0.3 eV. The isochronal annealing spectrum was also examined after quenches from above 2800°K. Over 80% of the quenched-in resistance annealed away at 850 to 1150°K. After quenches from below 3100°K, this stage was centered in the upper portion of this temperature range. After quenches from higher temperatures, the annealing stage shifted toward lower temperatures, and some resistance remained after the stage was completed. Isothermal annealing studies were made in the range 800 to 1040°K after quenches from above 3200°K. The curves had a complex shape, the rate initially increasing with increasing annealing time. Measurements yielded an activation energy for migration of 1.5 ± 0.2 eV, considerably smaller than the high temperature estimate of 2.5 eV for the single vacancy motion energy. These results are all suggestive of vacancy clustering during the quench and subsequent annealing. The apparent inconsistency between the conclusion that clustering is important, and Gripshover's tentative conclusion that it is not, can be traced to the value of 5.2 eV used by Gripshover for the activation energy of self-diffusion in tungsten. Analysis of his data using the recent value of 6.1 eV yields results entirely consistent with our interpretation. A new method for loading multiple samples into a field ion microscope is described, which allows sequential examination of the samples without loss of cooling or degradation of vacuum. Two operating systems are described. Experimental techniques for quantitative defect studies in a field ion microscope are also described. (DLC)

13177 SUPERPLASTIC DEFORMATION AND HIGH-TEMPERATURE CREEP OF A MONOTECTOID-COMPOSITION URANIUM-BASE ALLOY. Bly, D. L. Stanford, CA; Stanford Univ. (1973). 182p. University Microfilms Order No. 73-30,369.

Thesis (Ph. D.).

The elevated-temperature creep properties of a monotectoid-composition uranium-base alloy were studied as a function of microstructure. The alloy was U–7.5Nb–2.5Zr. Three areas of investigation were undertaken: (1) thermomechanical processing techniques to achieve a fine-grain equiaxed $\alpha + \gamma_1$ microstructure; (2) creep deformation of the fine-grain equiaxed $\alpha + \gamma_1$ structure; (3) creep deformation of the coarse-grain γ structure. At high stresses where $\tau/G > 10^{-3}$, there was a transition from superplastic creep to dislocation climb-controlled creep where the stress exponent is 5. When annealed to form a single γ phase with a 40 μm grain size, the U–7.5Nb–2.5Zr alloy deformed by a viscous glide creep mechanism during initial straining ($\epsilon = 0.01$) at 670 to 1000°C. Structural changes occurred during deformation at 670 to 1000°C. (DLC)

13178 TEMPERATURE DEPENDENCE OF THE INTERNAL MAGNETIC FIELD AND QUADRUPOLE COUPLING IN THE MAGNETICALLY ORDERED Dy–Gd SYSTEM. Sweger, D. M. Washington, DC; American Univ. (1973). 98p. University Microfilms Order No. 73-28,768.

Thesis (Ph. D.).

Nuclear hyperfine magnetic and quadrupolar interaction studies were performed using the ^{161}Dy Mössbauer resonance in the magnetic system Dy_xGd_{1-x}. A high velocity constant acceleration Mössbauer spectrometer capable of velocities in the range ±25 cm/s was designed and built. In addition, a temperature controller was designed and built to be used in conjunction with the cryogenic apparatus. The magnetic hyperfine field and quadrupole coupling were measured as a function of concentration and temperature up to the Néel (Curie) points. The data for $H_{int}(T)$ are compared to existing molecular field and spin-wave theories, and it is found that spin-wave theory, when an anisotropy energy gap of the order of 24 K is included in the spin-wave spectrum, is in reasonably good agreement with the $H_{int}(T)$ data below 0.5 T_N (T_C). The temperature dependence of the data for quadrupole coupling is in good agreement with a theory by Callen and Callen and indicates that the dominant contribution to V_{zz} is the single ion magnetocrystalline anisotropy rather than a Boltzmann average of $[3J_z^2-J(J+1)]$. (Diss. Abstr. Int., B)

13179 ELECTRICAL RESISTIVITY AND EMISSIVITY OF SOME TRANSITION METALS AND ALLOYS IN THE HIGH-TEMPERATURE RANGE. Zhorov, G.A. (Moscow). High Temp. 10: No. 6, 1202-1204 (July 1973).

Results are reported from simultaneous measurements of the emissivity and specific electrical resistivity of W, Re, steel-15, Ta, the alloy Ti–4Al–2.1V–1.2Cr–7.65Mo, and the alloy Zr–1Nb above 1000°K. (LMT)

13180 MELTING POINT OF NIOBIUM. Berezin, B.Y.; Kenisarin, M.M.; Chekhovskoi, V.Y. (Institute of High Temperatures, Academy of Sciences of the USSR). High Temp. 10: No. 6, 1092-1094 (July 1973).

The melting point of 99.7% pure niobium was found to be 2469°C. This was the result of 21 measurements carried out using two EOP optical monochromatic pyrometers and a model of the absolute black body. (auth)

13181 TRANSFORMATION BEHAVIOR OF A U–16.4 AT. % Nb–5.6 AT. % Zr ALLOY. Karnowsky, M. M.; Rohde, R. W. (Sandia Labs., Albuquerque, NM). J. Nucl. Mater.; 49: No. 1, 81-90 (Nov 1973).

The isothermal transformation kinetics of a γ-phase U–16.4 at. % Nb–5.6 at. % Zr alloy were studied by resistometric techniques between 130 and 590°C. Three distinct regions of transformation were observed. Above 420°C, the transformation proceeded by nucleation and growth and progressed to the equilibrium $\alpha + \gamma_2$ phases. Aging at temperatures between 270 and 400°C resulted in the appearance of a transition α'' monoclinic phase that remained stable after even 7 days of aging at 380°C. Aging below 250°C produced a tetragonal γ^0 phase. A negative temperature coefficient of resistance is observed at temperatures below 400°C when the material is quenched from a 900°C anneal. It is suggested that 400°C represents an athermal γ to γ^s transformation and that the negative resistance coefficient results from a continual change of lattice parameters of γ^s with decreasing temperature. (8 figures, 25 references) (auth)

13182 X-RAY STUDY OF β-TANTALUM. Burbank, R. D. (Bell Telephone Labs., Inc., Murray Hill, NJ). J. Appl. Crystallogr.; 6: No. 3, 217-224 (1 Jun 1973).

A 7.5μ-thick β-Ta film with very high preferred orientation was studied with both Gandolfi and precession cameras. A hexagonal subcell with a = 2.831, c = 5.337 Å was found. The smallest hexagonal cell that accounts for all the observed spacings contains 144 subcells with a = 34 Å. A structural model is proposed based on analysis of the subcell. It suggests that there are domains in the form of hexagonal prisms about 1000 Å or more in height and about 250 Å in diameter. The domains are divided into 12 coherently diffracting prismatic zones with impurity species, principally Ar and H_2, incorporated into the zone boundaries. The structure within a zone is related to the simple hcp structure. The domains are stacked together side by side, normal to the plane of the film, to form layers. Many layers in turn may be added together to form the complete film. (auth)

13183 KINETICS OF NITROGEN ABSORPTION BY Nb AND ITS ALLOYS WITH Zr IN PLASMA-ARC MELTING. Erokhin, A. A.; Moiseev, V. F.; Pankratov, N. N.; Rykalin, N. N.; Trefilov, V. I. Fiz. Khim. Obrab. Mater.; No. 4, 42-45 (1973). (In Russian).

Absorption of nitrogen by alloys of niobium with zirconium is described by a first-order equation and occurs in a diffusion regime. The mass-transfer coefficient in the pressure interval studied may be considered a linear function of the nitrogen partial pressure. It decreases somewhat with increase in the zirconium content. At $p_{N_2} > 0.001$ atm, the nitrogen activity coefficient in liquid niobium is greater than 1 and increases with increase in the nitrogen partial pressure. For the same nitrogen partial pressures,

the nitrogen activity coefficient in ternary niobium–zirconium–nitrogen alloys is lower than in binary niobium–nitrogen alloys. (tr-auth)

13184 REGULARITIES OF PLASTIC DEFORMATION OF MONOCRYSTALLINE Mo CHARGED WITH CONTACT FRICTION FORCES THROUGH PLASTIC METALS. Molchanov, B. A.; Karakozov, E. S.; Alekhin, V. P. Fiz. Khim. Obrab. Mater.; No. 4, 84–88(1973). (In Russian).

The regularities of plastic deformation of the pre-surface layers of monocrystalline molybdenum charged with contact friction forces were studied by the "soft puncture" method. It was shown that the chief regularities of dislocation formation in a monocrystalline molybdenum base when a plastic deforming medium (Al, Ag, Cu) is spread on its surface coincide with the earlier appearing regularities of contact plastic deformation of a metal–semiconductor combination. (tr-auth)

13185 INCREASE IN Mo PLASTICITY AFTER APPLICATION OF HYDROSTATIC PRESSURE. Gural'nik, E. Kh.; Maksimov, L. Yu.; Mukhin, G. G.; Slobtsov, V. E. Fiz. Khim. Obrab. Mater.; No. 4, 89–92(1973). (In Russian).

The causes of the increase in molybdenum plasticity after the application of hydrostatic pressure, with reduction up to 82%, were investigated. It was shown that one cause is the breakdown of large boundary layers of carbide phase in the initial material. (tr-auth)

13186 SPATIAL DISTRIBUTION OF CHARGED PARTICLES IN A VACUUM CHAMBER IN ELECTRON-BEAM VAPORIZATION OF SUBSTANCES. Osipov, K. A.; Borovich, T. L.; Orlov, I. I. Fiz. Khim. Obrab. Mater.; No. 4, 138–140(1973). (In Russian).

The spatial distribution of charged particles in a vacuum chamber was studied during vaporization of material from a water-cooled copper crucible by an electron beam that is reversible by use of a magnetic field. It was established that the charged-particle beam falling on the base could be decreased by proper selection of the size and location of magnetic conductors relative to the beam and the crucible and optimum location of the base. (tr-auth)

13187 TRANSFORMATION DIAGRAM FOR A CONTINUOUSLY COOLED Ti–6% Al–6% V–2% Sn ALLOY HOMOGENIZED IN THE β_0 PHASE. Gueret, G.; Fries, J. F.; Cizeron, G.; Lacombe, P. (Paris Univ., Orsay, France). Compt. Rend., Ser. C; 227: No. 6, 267-270(6 Aug 1973). (In French).

The transformation diagram for a continuously cooled titanium alloy (TA 6–V 6–E 2) was determined after a prior homogenizing in the β_0 phase. When the quenching rate is altered within very large limits, three different types of structural behavior can take place, leading to two types of acicular martensite or to a pseudo-bulk martensite at high temperatures. (FR)

13188 LOW-TEMPERATURE HEAT CAPACITIES AND RELATED THERMAL PROPERTIES OF $TbAl_2$ AND $HoAl_2$. Hill, T. W.; Wallace, W. E.; Craig, R. S.; Inoue, T. (Univ. of Pittsburgh). J. Solid State Chem.; 8: No. 4, 364-367(Dec 1973).

Data on the heat capacities of $TbAl_2$ and $HoAl_2$ for the range 5 to 300°K are presented. The magnetic contribution, (C_p)mag, for $TbAl_2$ is very broad, resembling that for $GdAl_2$. (C_p)mag for $HoAl_2$ is generally similar but, in addition, peaks in C_p are observed at 20 and 28°K. The measured magnetic entropies for the two compounds are only about 80% of $R\ln(2J + 1)$. The possibility cannot be excluded that the ground state is doubly degenerate in these cases. The data are treated to give values of the Third Law Entropy (S), $H-H_0^1$ and $F-H_0^1$. (auth)

13189 EVALUATION OF THE ELEVATED-TEMPERATURE TENSILE AND CREEP-RUPTURE PROPERTIES OF 1/2 Cr–1/2 Mo, 1 Cr–1/2 Mo, AND 1 AND 1/4 Cr–1/2 Mo–Si STEELS. Smith, G. V. ASTM Data Series Publication DS 50. Philadelphia; American Society for Testing and Materials (1973). 162p. $8.25.

The elevated-temperature strength and ductility of three low chromium–molybdenum steels are evaluated. Included in the evaluations are previously unpublished test results as well as test results previously published in ASTM Data Series DS 6 (1953) and DS 6S1 (1966). Employing a normalization procedure that involves establishing the ratio between the elevated-temperature strength of a particular test lot and the room-temperature strength of that same lot, then applying the method of least squares, trend curves depicting the characteristic temperature variations of yield and tensile strengths have been developed. The rupture and secondary-creep-rate data were evaluated by both direct isothermal interpolation or extrapolation, and by the time–temperature parameter, to establish the temperature dependencies of the average and minimum stresses causing rupture in 1000, 10,000, and 100,000 hours, and of average and minimum stresses causing secondary creep rates of 0.1 and 0.01% per 1000 hours. Elongation and reduction of area data are included for both the short-time tensile tests and for the rupture tests. The body of the report provides details concerning the identity of the individual lots, the evaluation procedures, and the results. (JRD)

13190 TEMPERATURE DEPENDENCE OF THE ELECTRIC FIELD GRADIENT AT YTTERBIUM IMPURITIES IN THULIUM METAL. Chuhran-Long, A.R.; Li-Scholz, A. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19104); Rasera, R.L. Phys. Rev. B 8: No. 5, 1791-1798 (1 Sept 1973).

Time-differential perturbed angular correlations of nuclear γ rays from the decay of ^{172}Lu to ^{172}Yb have been used to measure the temperature dependence of the electric quadrupole hyperfine interaction at dilute ytterbium impurities in polycrystalline thulium metal over the temperature range from 77 to 560 K. The dependence on temperature is found to be relatively weak and almost linear. Based on a value for the quadrupole moment of the 79-keV state obtained from Coulomb-excitation transition probabilities, the electric field gradient (EFG) is $(6.15 \pm 0.15) \times 10^{17}$ V/cm^2 at 77 K, and decreases with increasing temperature by $(6.6 \pm 0.6) \times 10^{-4}$ K^{-1} of the extrapolated value of $V_{zz}(0\ K) = 6.33 \times 10^{17}$ V/cm^2, with some evidence of leveling off above 500 K. Such a linear temperature dependence is inconsistent with any appreciable contribution to the EFG from an open 4f shell, and thus the ionic state of the ytterbium ion is dipositive. The observed EFG is thus due to contributions from the crystal-field and conduction electrons. The temperature variation of the lattice EFG comes mainly from the anisotropy of thermal expansion between the c axis and the basal plane of the thulium lattice. Estimates based on point-charge calculations of the crystal field combined with measured thermal-expansion coefficients yield a magnitude and temperature dependence that are both too small to explain the observed results on this basis. The remaining temperature dependence is ascribed to the effects of local conduction electrons near the Fermi surface. (auth)

13191 HIGH-RESOLUTION STUDY OF ISOMER SHIFTS OF THE 6.2–keV γ RAYS OF TANTALUM–181. Kaindl, G.; Salomon, D. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720); Wortmann, G. Phys. Rev. B 8: No. 5, 1912-1923 (1 Sept 1973).

Isomer shifts of the 6.2-keV γ rays of ^{181}Ta are reported for dilute impurities of tantalum in transition-metal hosts and for several tantalum compounds. The experimental line-shift-to-linewidth ratios represent an improvement of the resolution by more than an order of magnitude relative to other Mössbauer resonances. For ^{181}Ta impurities in transition-metal hosts a systematic variation of the electron density at the nucleus is found. From a comparison of the isomer shifts of ^{181}Ta impurities in transition-metal host with those observed for impurities of ^{57}Fe, ^{99}Ru, ^{193}Ir, and ^{197}Au, a value of $\Delta\langle r^2\rangle = -5 \times 10^{-2}$ fm^2 can be derived for the change of the mean-squared nuclear-charge radius. The negative sign of $\Delta\langle r^2\rangle$ is in agreement with the observed variation of the isomer shifts of $LiTaO_3$, $NaTaO_3$, and $KTaO_3$, as well as with the isomer shift found for TaC. (auth)

13192 GYROMAGNETIC RATIOS OF METALLIC SAMARIUM COMPOUNDS. Stewart, A.M. (Center for Theoretical Studies, University of Miami, P. O. Box 9055, Coral Gables, Florida 33124). Phys. Rev. B 8: No. 5, 2214-2221 (1 Sept 1973).

In metallic rare-earth compounds the exchange interaction between the 4f shell and the conduction electrons causes a portion of the conduction-electron magnetization to be added to the magnetization of each rare-earth atom. Because these two magnetization components will, in general, have different gyromagnetic ratios, it follows that the gyromagnetic ratio of the whole material will differ from that of the rare-earth ions alone, which is given by the Landé factor. For the rare-earth metals apart from samarium, the resulting gyromagnetic ratio shifts are estimated to be of the order of 1%, too small to be detected by present experimental methods. However, an exploratory calculation suggests that the shift might be very large, perhaps of the order of 100%, in a samarium compound in which the interactions were of a strength comparable to those which are found in elemental samarium metal. (auth)

13193 INELASTIC-NEUTRON-SCATTERING STUDY OF ACOUSTIC PHONONS IN Nb_3Sn. Axe, J.D.; Shirane, G. (Brookhaven National Laboratory, Upton, New York 11973). Phys. Rev. B 8: No. 5, 1965-1977 (1 Sept 1973).

Transverse-acoustic-phonon frequencies and line shapes have been studied as a function of temperature in Nb_3Sn. There is a substantial ($\approx$ 10%) reduction in all of the mode frequencies studied between 300 °K and the cubic-tetragonal transformation temperature T_M = 45 °K. Even more pronounced elastic softening is observed for $[\xi\xi 0]T_1$ phonons with $q < q_{z.b.}/10$. As $T \to T_M$ from above, phonons in this latter group acquire an unusual quasielastic "central" component in addition to the phononlike sidebands. The evolution of this central component is adequately described by a phenomenological theory which assumes an additional low-frequency relaxation mechanism for the acoustic phonons. Finally, abrupt changes in certain phonon lifetimes are detected near the superconducting transformation temperature T_c = 18.0 °K. This behavior is traced to the the inability of phonons with energies less than that of the superconducting gap $2\Delta(T)$ to decay by creation of

excited electron-quasiparticle pairs. These measurements give an estimate of $2\Delta(0) = (4.4 \pm 0.6)k_BT_c$ and reveal a strong anisotropy in the electron-transverse-phonon interaction. (auth)

13194 CRYSTAL STRUCTURE OF TERNARY COMPOUNDS ZrVSi AND HfVSi. Yarmolyuk, Ya. P.; Loub, J.; Gladyshevskii, E. I. (Lvov State Univ.). Dopov. Akad. Nauk Ukr. RSR, Ser. A; 10, 943-945(1973). (In Russian).

The existence of 2 new compounds of equiatomic composition of PbFCl structure type was established in {Zr, Hf}-V-Si systems by means of x-ray-diffraction analysis (single-crystal and powder methods). The lattice parameters of the investigated compounds are: ZrVSi, a = 3.695, c = 7.212 Å; HfVSi, a = 3.662, c = 7.135 Å. (auth)

13195 TERNARY COMPOUNDS WITH THE $Mg_6Cu_{16}Si_7$ TYPE STRUCTURE IN SOME SYSTEMS OF TWO TRANSITION METALS WITH ALUMINUM AND GALLIUM. Markiv, V. Ya.; Storozhenko, A. I. (Kiev State Univ.). Dopov. Akad. Nauk Ukr. RSR, Ser. A; No. 10, 941-943(1973). (In Russian).

The x-ray diffraction study of the Sc-X'-Al and R-X'-Ga systems alloys where R = Sc, Ti, Zr, Hf; X' = Ru, Os, Rh, Ir, Pd, Pt in the region either $Sc_6X'_7Al_{16}$ or $R_6X'_7Ga_{16}$ resulted in establishing the existence of 23 new ternary compounds with the $Mg_6Cu_{16}Si_7$ type structure. Comparison of the systems R-X'-Al studied previously mainly for the purpose of forming T phases and R-X'-Ga shows that the greatest tendency to form T phases exists in the systems when the R component is presented by titanium or zirconium, as well as in those where X' is presented by the cobalt-subgroup elements. (auth)

13196 THERMAL CREEP OF THE NUCLEAR FUELS UO_2 AND UO_2-PuO_2 IN THE RANGE OF STRESS BETWEEN 40 AND 100 N/mm². Assmann, H. Erlangen, Ger.; Erlangen-Nuernberg Univ., Erlangen, Ger. (1972). 92p. (In German).

Thesis.

Sintered bodies of UO_2 and UO_2-PuO_2 with reduced density were deformed under vacuum at constant load in the temperature range between 1300 and 1800°C and at a stress ranging from 40 to 100 N/mm². Semilogarithmic plottings of the creep rate against ϵ (deformation) and against exp ($-\epsilon$) showed linear relationships within the range of the stationary creep and within certain sections of the transition creep. These linear relationships can be explained theoretically. The transition creep phenomena were interpreted by the dislocation kinetics and the model of internal stresses. The stationary creep can be described in relation to the stress dependence. In principle, the activation volume is indirectly proportional to the stress applied, and its temperature dependence is described by an Arrhenius function. Measurements on UO_2-PuO_2 resulted in values between 100 and about 170 kcal/mol for the effective activation energy. In addition to the creep tests, ceramographic and chemical investigations were made to characterize the samples prior to and after creep test. (GE)

13197 MASS-SPECTROMETRIC INVESTIGATIONS OF BACKGROUND GASES DURING THE SPUTTERING OF TANTALUM. Hardy, W. R.; Mills, D. (Microsystems International Ltd., Ottawa). Thin Solid Films; 18: No. 2, 309-319(Nov 1973).

The time dependence of the partial pressures of H_2^+, O_2^+, CH_4^+, H_2O^+, N_2^+ and a combination of CO^+ and $C_2H_4^+$ have been monitored continuously during and after the sputtering of Ta. With the exception of O_2^+, these components undergo a transient increase on initiation of sputtering. The increase in the background CH_4^+ is attributed to desorption and dissociation of heavier hydrocarbons by the discharge. This CH_4 may itself be dissociated, thus contributing to the increase in the background H_2 partial pressure. H_2 is also produced by the desorption and dissociation of H_2O. The background oxygen partial pressure is reduced by a factor of five during sputtering. An oxygen exposure of 1×10^2 Langmuir produces about one monolayer of oxide on sputtered Ta. For films reactively sputtered in oxygen the resistivity decreases as the length of the baking cycle prior to sputtering is increased. This shift with baking time may be attributed to a decrease in the quantity of water vapor desorbed by the discharge, and thus a decrease in the total oxygen concentration in the films. (auth)

13198 SIMPLE MODEL FOR ALLOYS. Miedema, A. R. (Philips Research Labs., Eindhoven, Netherlands). Philips Tech. Rev.; 33: No. 6, 149-160(1973).

A simple atomic model for alloys is presented, which although empirical like models based on the other rules nevertheless has a clear physical basis and can be used to predict the alloying behavior of transition metals correctly in 98% of cases. In this model there are two quantities that determine the heat of formation: a negative one associated with the difference in electronegativity that must be taken as proportional to the experimental value of the work function; and a positive one corresponding to the difference in electron density at the boundary of the atomic cells of the metals. For alloys of transition metals with polyvalent nontransition metals, there is also a third contribution to the heat of formation that is independent of which transition metal is alloyed with which particular p metal. None of this is affected by the atomic size; this is only of significance in deciding whether two metals are able to form solid solutions and not whether stable alloys exist. (auth)

13199 STRUKTURA SPLAVOV TSIRKONIYA. (Structure of Zirconium Alloys). Ivanov, O. S.; Adamova, A. S.; Tararaeva, E. M.; Tregubov, I. A. Moscow; Izdatel'stvo Nauka (1973). 199p.

The structure of zirconium alloys in states of equilibrium and nonequilibrium is examined. The structure in the state of equilibrium is analyzed from structural diagrams of binary and ternary systems on a zirconium base. General rules are given for the formation of metastable phases in zirconium alloys and the structure of alloys in a nonequilibrium state in phase diagrams of binary and ternary alloys. A list of the investigated systems is presented. (8 tables, 222 figures, 594 references) (JPRS)

13200 MUTUAL SOLUBILITY OF THE LOWER GERMANIDES OF CHROMIUM AND VANADIUM. Osipova, S. G.; Shtol'ts, A. K.; Gel'd, P. V. (Ural Polytechnical Inst., Sverdlovsk, USSR). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 5, 773-774(May 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 5, 860-861(May 1973).

Binary V-Ge and Cr-Ge alloys were prepared along with ternary Ge-Cr-V alloys and subjected to homogenizing annealing at 1000°C for 150 h. Results of metallographic and x-ray analyses are presented that show continuous solid solutions with A15 lattice structure are formed in a quasi-binary cross section $V_{3.04}Ge_{0.96}$-Cr_3Ge. (JRD)

13201 SYSTEM CERIUM-NICKEL-SILICON IN THE REGION 33.3 TO 100 AT. % Ce. Bodak, O. I.; Mis'kiv, M. G.; Tyvanchuk, A. T.; Kharchenko, O. I.; Gladyshevskii, E. I. (Lvov State Univ.). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 5, 777-779(May 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 5, 864-866(May 1973).

Phase equilibria in the system Ce-Ni-Si in the region 33.3 to 100 at.% Ce were studied by x-ray and microstructural methods. It was found that the system Ce-Ni-Si has more ternary compounds than any other known Si-containing ternary system and that the number of compounds formed in the systems Ce-M-Si (M is Fe, Co, or Ni) increases with the atomic number of the metal of the iron family from five for the system Ce-Fe-Si to seven for the system Ce-Co-Si and to 21 for the system Ce-Ni-Si. Data on compounds in the system are included along with phase diagrams. (JRD)

13202 KINETICS OF PRECIPITATION PROCESSES WITHIN REGION AFFECTED BY HEAT OF WELDED JOINTS OF THE REACTOR STRUCTURAL STEEL 22NiMoCr37. Grosse-Woerdemann, J. (Westfaelische Union AG, Hamm, Ger. F.R. Germany; (1973). vp. (In German).

From welding techniques meeting 1973 and 8th international industrial fair for welding and cutting; Essen (19 Sep 1973).

The kinetics of the dissolution-precipitation mechanism of carbides and nitrides in connection with the welding process and the following heat treatment for stress relief was studied as a contribution to a better understanding of the phenomenon "stress relief cracking". (GE)

13203 EXCITATIONS IN MAGNETIC SYSTEMS WITH VARIOUS CRYSTAL-FIELD LEVEL SCHEMES. Hsieh, Y. Y. (St. Francis Xavier Univ., Antigonish, N. S.). Can. J. Phys.; 51: No. 1, 50-62(1 Jan 1973).

The Hamiltonian constructed in pseudo-spin space to explain the crystal-field effects in certain magnetic systems with various crystal-field level schemes was studied in the random phase approximation of the double-time Green function method. By using the molecular field results obtained before as a second approximation, low-lying collective excitation spectra at zero and finite temperatures were obtained. As an application the calculations were extended to look at the dispersion curves of dhcp praseodymium single crystal. Comparison with experimental measurements is discussed. Suggestions on further studies and possible improvements of the present calculations are also provided. (auth)

13204 CRYSTAL STRUCTURE OF β-TANTALUM. Moseley, P. T.; Seabrook, C. J. (United Kingdom Atomic Energy Authority, Harwell, Eng.). Acta Crystallogr., Sect. B; 29: No. 5, 1170-1171 (15 May 1973).

The x-ray powder pattern of β-tantalum is indexed in terms of a tetragonal unit cell with a = 10.194 and c = 5.313 Å. β-Tantalum appears to be isomorphous with β-uranium. (auth)

13205 PHASE RELATIONS AND MECHANICAL PROPERTIES OF Ti–Mo–Al ALLOYS. Hamajima, T. New Brunswick, NJ; Rutgers–The State Univ. (1973). 119p. University Microfilms Order No. 73-27,934.

Thesis (Ph. D.).

Microstructures and phase relations were investigated for the titanium-rich composition of the Ti–Mo–Al system. It was found that the four-phase equilibrium β(bcc) + $Ti_3Al(DO_{19})$ $\rightleftharpoons$ α(hcp) + β_2(B2, Ti_2–MoAl) exists at a temperature of about 550°C. Above this temperature, a two-phase region namely a β + Ti_3Al region exists. β transus (the β/β + Ti_3Al temperature) increases with increase of aluminum content and the two-phase region extends, on the isopleth of the phase diagram at 7 at.%Mo from 900°C for 7 at.%Mo–12 at.%Al to 1300°C for 7 at.%Mo–24 at.%Al. The mechanical properties of α-β type titanium alloys are greatly affected by the size, shape, distribution, and hardness of the precipitated α and Ti_3Al particles respectively. α particles embedded in β matrix are relatively soft and at the initial stage of plastic deformation, deform preferentially and work harden very rapidly, especially when the particles are small. By contrast, Ti_3Al particles are hard and are undeformed plastically even after 2% matrix deformation. The hardness of Ti_3Al derives from its ordered structure. From a practical viewpoint, it was found that alloys with a β + Ti_3Al microstructure have high yield stress and good ductility when the volume fraction of Ti_3Al phase is low and when precipitation of coherent β_2 particles is suppressed. It was also shown that the alloy does not lose its good mechanical properties by aging at intermediate temperatures. (Diss. Abstr. Int., B)

13206 LOCALIZED OBSTACLES TO LOW-TEMPERATURE DISLOCATION MOTION IN BCC TUNGSTEN. Dralla, J. R. Stony Brook, NY; State Univ. of New York (1973). 93p. University Microfilms Order No. 73-27,078.

Thesis (Ph. D.).

There has been great concern in the last two decades with understanding the limits of dislocation motion, and therefore ductility, in bcc metals. The effect of interstitial elements is known to be quite important in controlling macroscopic flow in tungsten, but current understanding of the microscopic processes is limited. The localized obstacles to dislocation motion in tungsten single crystals at 4.2 to 298°K are examined using a compressional microstrain technique. Crystals of (100), (110), (111) and 14° -(100) orientation were studied in relation to dislocation structure and ultra-high vacuum electron bombardment purification procedures, and correlated with microstrain parameters. Ultrahigh vacuum degassing reduced both the dislocation and interstitial content while increasing the residual resistivity ratio, RRR $\equiv \rho$ 273°K/ρ 4.2°K $\simeq 2 \times 10^3$. Comparison with chemical and partial gas-mass spectroscopy measurements for the determination of impurity content indicated total interstitial content less than 1 ppM. Dislocation densities of the various orientation crystals varied from $\simeq 6 \times 10^5$ to 3×10^6/cm^2. Elastic limit determinations of crystals of varying purity levels gave an average value of $\sigma_E \simeq 0.10$ kg/mm^2 at 298°K and a mild temperature dependence below 150°K. σ_E is $\simeq 0.35$ kg/mm^2 for as-grown and σ_E is $\simeq 0.20$ kg/mm^2 at 4.2°K for crystals of ultra-high purity. Anelastic limit values were found to be strongly dependent on purity levels at 4.2°K. Thermal activation analysis, in terms of the activation parameter v*, gave values of $2 \times 10^3 b^3$ in the microstrain region. The results of etch pit motion experiments at 4.2°K revealed dislocation velocities of 5×10^{-6} cm/sec ± 20%. Dislocation damping loops at low stress levels $\simeq$10 kg/mm^2, as defined by the decrement Δ, were found to be dependent on the magnitudes of the stress amplitude. Relative to the stored energy in the specimens, the energy loss rises to a maximum at $\simeq$1 kg/mm^2, and then falls off to a plateau value up to the anelastic limit, σ_A. Associated with the anelastic limit and its decrease in magnitude with increasing temperatures is the "trapping" of dislocations at large strain amplitudes, $\simeq 10^{-4}$ by impurity atoms. The use of the pinned string model of dislocation bowing was found insufficient to explain the large amounts of fractional modulus change. Edge dislocation motion and interaction with interstitial impurities are believed to control the initial motion of dislocations and subsequent damping behavior. (Diss. Abstr. Int., B)

13207 ELASTIC CONSTANTS OF DILUTE Mo-Re ALLOYS: A SECOND-NEIGHBOR MODEL. Kesharwani, K.M.; Agrawal, B.K. (Physics Department, Allahabad University, Allahabad-211002, India). Phys. Rev. B 8: No. 6, 3056-3058 (15 Sept 1973).

The effects of a relatively high concentration of point defects on the elastic properties of a bcc crystal in the Elliott–Taylor approximation have been studied by using a defect perturbation model extending up to second neighbors. Numerical calculations have been performed for two experimentally studied Mo–Re (7 and 7.4%) alloys. It is observed that the changes in the second-neighbor force constants are very small and the perturbation may well be described by a nearest-neighbor defect model. The results obtained in the Elliott–Taylor approximation are seen to be very near to those obtained in the lowest-order concentration theory. (auth)

13208 INFLUENCE OF MICROPORES ON THE HIGH-TEMPERATURE CREEP RUPTURE OF POWDER-METALLURGICAL TUNGSTEN WIRES. Horacsek, O.; Bartha, L. (Research Inst. for Technical Physics, Budapest). Phys. Sintering; 5: No. 2/2, 85-94(1973).

From third international round table meeting on sintering; Herceg Novi, Yugoslavia (3 Sep 1973).

The effects of doping on cavitation phenomena associated with high-temperature deformation of W wires are described. Undoped and KSiAl-doped wires were used in the experiments. The doped specimens in tests to rupture showed holes at grain boundaries and inside grains. Hole growth in doped wires was slower than in pure undoped material. It was found that after elongations which caused the doped wires to break, no cavities could be found in the undoped wires. These cavities became visible under magnification after deformation of 1.5 to 2%. (JRD)

13209 SHORT-RANGE ORDER AND DEVELOPMENT OF LONG-RANGE ORDER IN Ni_4Mo. (1973). vp.

From international symposium on order–disorder transformation in alloys; Tuebingen, Germany (3 Sep 1973).

The short-range ordered structure present in quenched Ni_4Mo and the initial development of the long-range-ordered structure in this alloy were studied using single-crystal x-ray diffuse-scattering techniques. Measurements of the diffuse x-ray intensities were made in a volume in reciprocal space for the fcc alloy resulting in a quantitative determination of the three-dimensional local-order parameters. The local-order parameters were used for a computer simulation of the atomic configuration. (GE)

13210 NMR ANALYSIS OF THE EXCHANGE INTERACTION IN FERROMAGNETIC RARE-EARTH–ZINC COMPOUNDS. Eckrich, K. (Technische Univ., Darmstadt, Ger.); Dormann, E.; Oppelt, A.; Buschow, K. H. J. Int. J. Magn.; 5: No. 1-3, 75-80 (1973).

By comparison of the NMR spectrum of GdZn with those of the compounds $Gd_{0.9}X_{0.1}Zn$; (X = Y, La, or magnetic RE), the contribution of the magnetic RE neighbor to the hyperfine field of the nonmagnetic zinc is determined. In the case of GdZn, 85% of the Zn hyperfine field is caused by the nearest Gd shell. The effective exchange parameters derived from magnetic measurements (e.g., paramagnetic Curie temperature) on the binary intermetallic compounds with CsCl structure are compared with the effective exchange parameters yielded by interaction of nearest neighbors, as estimated from NMR on the pseudobinary compounds. (auth)

13211 ELECTRICAL CONDUCTIVITY AND SUPERCONDUCTIVITY OF VANADIUM, NIOBIUM, AND CHROMIUM SOLID SOLUTIONS. Sirota, N. N.; Fedotov, A. K. (Physical-Technical Inst. of Low Temperatures, Minsk). Compt. Rend. Acad. Bulg. Sci.; 17: 613-616(Jul 1973). (In Russian).

The temperature dependence of the resistivity of solid solutions of the V–Nb–Cr system is studied in the temperature range from 2 to 350°K. It is shown that at temperatures below 50°K, the temperature dependence of the resistivity is proportional to the squared temperature, and is linear above 200 to 250°K. A correlation between the superconductivity parameters of dilute V–Cr and Nb–Cr alloys and their resistivity at temperatures above the Debye temperatures is established. (IAA)

13212 IRRADIATED ZIRCON STRUCTURAL DEFECTS AS STUDIED BY THE ESR METHOD. Solntsev, V. P.; Shcherbakova, M. Ya. (Inst. of Geology and Geophysics, Novosibirsk, USSR). Dokl. Akad. Nauk SSSR; 212: No. 1, 156-158(1 Sep 1973). (In Russian).

Data on radiation paramagnetic centers were used to identify contaminant elements and defects in $ZrSiO_4$. It was established that the ratio of the intensities of paramagnetic centers in zircon may be used as one of the typical conditions of mineralization since it is a determining factor in formation of natural and contaminant defects. (TTT)

13213 INFLUENCE OF ELECTRONIC STRUCTURE OF AN ATOMIC CORE ON THE ANNIHILATION OF POSITRONS IN RARE EARTH METALS. Szuszkiewicz, S. (Univ., Wroclaw). Acta Phys. Pol., A44: No. 5, 691-699(Nov 1973).

The angular distributions of annihilation quanta were measured for the following rare earth metals: La, Ce, Pr, Nd, Eu, Gd, Tb, Dy, Ho, and Yb. Distributions of absolute electron momenta in the samples under investigation were determined on the basis of experimental curves. Interpretation of maxima found in the absolute momentum distributions was carried out on the basis of Brillouin zone theory and used to calculate the positions of given maxima; results indicate good agreement with theoretical calculations.

Comparison was also made of the contribution of free electrons and bound electrons of the atomic cores in the annihilation process. Results indicate that the annihilation process between positrons and electrons of studied metals is affected not only by the number of electrons involved in the annihilation process but also by the electronic structure of the atomic core. 6 figures. (auth)

13214 NEW PRESSURE VESSEL TECHNOLOGY. Metal Progr.; 105: No. 2, 35-37; 40-42; 44; 46(Feb 1974).

An overview is presented of nine papers presented at the Second International Conference on Pressure Vessel Technology in San Antonio, Texas, Fall 1973. Four of the overviews pertain to alloy steels, three to testing, and two to fabrication. The papers are entitled: Quenched and Tempered Steels for Pressure Vessel Service at Elevated Temperatures; Nickel-Chromium-Molybdenum Steel Plate for Pressure Vessels; Radiation Embrittlement of Advanced Ni-Cr-Mo Steel Plates, Forgings, and Weldments; Flat Rolled and Hot-Formed Parts of High-Strengh Steels for Heavy Pressure Vessels; Nondestructive Testing of Unfired Pressure Vessels; Inspection of Steel Pressure Vessels by Acoustic Emission; Properties of Cr-Mo-V Steel from a Steam Line After 100,000 Hr of Service at 1,000 F; Cold-Stretched Austenitic Stainless Steel Pressure Vessels; and Recent Developments in Electron Beam Welding of Unalloyed Steel Joints. (MCW)

13215 SCIENCE OF MATERIALS USED IN ADVANCED TECHNOLOGY. Second International Course on Materials Science, Tremezzo, Italy, September 13-25, 1970. Parker, E. R.; Colombo, U. (eds.). New York, John Wiley and Sons, Inc. (1973). 568p. (CONF-700934).

The lectures, presented as 23 chapters, are devoted primarily to metallic materials. Information is included on solid state reactions and effects of structure on mechanical properties. Information is also included on engineering properties of plastics and composite materials. Materials for reactors, aerospace vehicles, and hydrospace vehicles are discussed. (JRD)

13216 THERMOTRANSPORT STUDIES IN LIQUID ALKALI METAL ALLOYS. Murarka, S. P.; Kim, T. Y.; Hsieh, M. Y.; Swalin, R. A. (Univ. of Minnesota, Minneapolis). Acta Met.; 22: No. 2, 185-189(Feb 1974).

Thermotransport was studied as a function of composition in the Na-K liquid alloy system. Thermotransport of trace concentrations of Rb in K, Rb in Na, and Na in Rb were also investigated. A reversal in direction of specie migration occurred at an intermediate composition in the Na-K system. In K-rich alloys, Na for example migrated toward the hot end of the capillary whereas in Na-rich alloys, Na migrated to the cold end. At some intermediate composition (between 64.6 and 76.6 at.% Na), a crossover occurred and consequently no thermotransport occurred at that composition. This study compares with electromigration studies by other investigators which indicate that a sign reversal in direction of electromigration occurs in both the Na-K and Na-Rb systems. Theoretical calculations of the heats of transport in the alloy systems studied yield quite good agreement with the observed sign of the heat transport for most of the alloys investigated. (auth)

13217 PRECIPITATION IN THE IRON-BERYLLIUM SYSTEM. Higgins, J.; Nicholson, R. B.; Wilkes, P. (Univ. of Manchester, Eng.). Acta Met.; 22: No. 2, 201-217(Feb 1974).

Results are reported for an electron microscope study of precipitation in 12 and 18 at.% Be alloys. The reaction sequence is shown to be (at low temperatures): Spinodal decomposition-FeBe ordering of Be-rich regions-intermediate tetragonal precipitate in Be-rich regions-equilibrium $FeBe_2$. The spinodal reaction and ordering were separated by direct quenching experiments and the ordering process observed directly. Coarsening of the composition modulations followed a $t^{1/3}$ law and gave an activation energy of 251 ± 16 kJ/mole. The modulation solvus (spinodal) was found by these direct quenching experiments which also gave the ordering temperature. Direct quenching to temperatures above the spinodal caused nucleation of $FeBe_2$ which in turn led to the formation of intermediate precipitate in adjacent regions. This followed a nodular, branching mode until all regions had transformed. Further aging gave $FeBe_2$. The solvus for the intermediate precipitate was found by direct quenching. The various precipitation regimes are summed up in a complete metastable phase diagram and the various products discussed in detail. (21 figures) (auth)

13218 DIFFUSION STUDIES IN LIQUID K AND Rb. Hsieh, M.; Swalin, R. A. (Univ. of Minnesota, Minneapolis). Acta Met.; 22: No. 2, 219-226(Feb 1974).

Self-diffusion coefficients were determined for liquid potassium and rubidium. The types of measurements made were self-diffusion of K and Rb as a function of temperature at one atmosphere pressure, the pressure dependence of self-diffusion coefficients of K and Rb, and the temperature dependence of self-diffusivity at constant molar volume. The self-diffusion coefficients in liquid K and Rb at 1 atmosphere pressure could be represented by the following expressions: D_K(354 to 868°K) = $-2.443 \times 10^{-5} + 5.344 \times 10^{-10}$ (T^0K)^2 cm^2/sec; D_{Rb}(337 to 856°K) = $-1.479 \times 10^{-5} + 3.824 \times 10^{-10}$ (T^0K)^{2}cm^2/sec. The empirical equation for both K and Rb may be expressed as $D/D_m = 1.665\,[(T/T_m)^2 - 0.399]$. The linear dependence of D vs T^2 for both Rb and K offers support to the predictions of the fluctuation theory proposed by Swalin. The experimental data also agree quite well with the dense gas-like model of Ascareli and Paskin. Activation volumes calculated from the data were 1.5 ± 0.5 cm^3 mol and 1.2 ± 0.4 cm^3/mol for liquid K and Rb, respectively. (auth)

13219 STRESS RELAXATION AND MECHANICAL EQUATION OF STATE IN BCC METALS IN MONOTONIC LOADING. Yamada, H.; Li, C. Y. (Cornell Univ., Ithaca, NY). Acta Met.; 22: No. 2, 249-253(Feb 1974).

Stress relaxation experiments in monotonic loading were performed on niobium and α-iron of two purity levels. The stress-strain rate relationship obtained at constant structures suggests that these metals exhibit the behavior of mechanical equation of state in the absence of discontinuous flow. (auth)

Radiation Effects

Refer also to abstracts 14036 and 14438.

13220 (COO-1198-1023) EFFECTS OF ELECTRON IRRADIATION ON P-TYPE GERMANIUM AT LIQUID HELIUM TEMPERATURES USING AC HOPPING CONDUCTIVITY. Roop, R. M. (Illinois Univ., Urbana (USA)). Oct 1973. Contract AT(11-1)-1198. 317p. Dep. NTIS $18.00.

Thesis.

P-type germanium single crystals (8×10^{14} Ga/cm^3 and 6×10^{15} Ga/cm^3) were irradiated with 1.1-MeV electrons at pumped liquid helium temperatures and defect production and annealing studied using ac hopping conductivity. Production rates obtained from measurements at 1.5°K and 10^4 Hz were 0.6 cm^{-1} for samples doped 6×10^{15} Ga/cm^3 and 0.11 cm^{-1} for samples doped 8×10^{14} Ga/cm^3. Above 10^{14} e/cm^2 fluence the production rates for the higher doped samples decreased to approximately 0.06 cm^{-1} at 10^{15} e/cm^2 fluence except for one sample which was anomalous. No such long irradiation of the low doped samples was made. The apparent inconsistency between these results and production rates of less than 3×10^{-4} cm^{-1} observed by previous workers was resolved by introducing a donor level for the defect produced by irradiation near the chemical acceptor level, so that the defect would be neutral at temperatures near 30°K and charged +1 at 1.5°K. Surface effects were observed which did not affect production rate measurements at 1.5°K more than ±10% but did influence annealing behavior at 100°K. The fact that the production rate observed increases with the impurity concentration leads to the conclusion that some defects must be mobile at the irradiation temperatures, which were usually 1.8°K. The fact that the production rate was 0.11 cm^{-1} ± 27% in the low doped p-type samples instead of 1.4 cm^{-1} or 0.95 ± 0.05 cm^{-1} as observed by other workers in n-type samples of similar dopant concentration also supports this conclusion. This led to the suggestion that germanium and silicon are similar as far as lattice vacancy and interstitial behavior. The similarity of the migration energies of the doubly negative vacancy in silicon to the activation energy of 65°K stage in n-type germanium thus indicates that this stage could be due to vacancy migration. The migration energy of the neutral vacancy in silicon is similar to the activation energy of the 200°K stage in p-type germanium observed by other workers. (auth)

13221 (COO-1799-10) CHARACTERIZATION AND BEHAVIOR OF ATOMIC HELIUM IN NIOBIUM. Johnson, D. L.; Cost, J. R. (Purdue Univ., Lafayette, Ind. (USA). School of Materials Engineering). 1973. 24p. (CONF-730813-11). Dep. NTIS $3.25.

From conference on defects and defect clusters in bcc metals and their alloys; Gaithersburg, Maryland, USA (14 Aug 1973).

High-purity niobium in the form of thin foil and wire was cyclotron injected with 0- to 46-MeV alpha particles to produce homogeneous helium concentrations of roughly 100 ppM. Lattice parameter measurements on an isochronally annealed irradiated specimen indicate that the as-injected helium is present substitutionally, probably as a helium-vacancy complex. A 180 ppM increase in the lattice parameter is found to occur with annealing near 200°C and is interpreted as being due to an initial stage in the precipitation of helium, but not the actual formation of bubbles. Measurements of helium loss to the surface of a foil specimen during isochronal annealing indicate that helium release occurs rapidly above 1000°C and continues to a maximum temperature above 1400°C until nearly all of the helium is released. The small

fraction (<5%) of the injected helium which was not released was found by transmission electron microscopy to be present as bubbles with an average radius of 15 Å; these were first observed at 1000°C. Anneals from 1000 to 2150°C for various times did not appear to change the bubble size or density (~10^{14} per cm^3). These results are interpreted in terms of the competitive processes of precipitation to form helium bubbles and the migration of point defect clusters involving helium to cause gas release. Comparisons are made with results in Al and Cu. (auth)

13222 (JPRS-60973) RADIATION SWELLING OF STEEL 0Kh18N9T. Bykov, V. N.; Vakhtin, A. G.; Dmitriev, V. D.; Kostromin, L. G.; Ladygin, A. Ya.; Shcherbak, V. I. Translated from At. Energ. (USSR); 35: No. 4, 235-237(1973). 7p. NTIS.

Results of electron-microscopic analysis of the radiation porosity of 0Kh18N9T steel are presented. Information is included on experimental materials and techniques, radioinduced porosity, and effects of temperature. (JRD)

13223 COMMENTS ON "ON THE ATOMIC DISPLACEMENT BY FAST NEUTRONS" BY OHMAE AND HIDA. Robinson, M. T.; Oen, O. S. (Oak Ridge National Lab., TN). J. Nucl. Mater.; 49: No. 1, 101-102(Nov 1973).

The assumptions made by Ohmae and Hida (J. Nucl. Mater., 42: 86(1972)) are given and criticized. The same result, that $N = (T + E_d)/3E_d$, was obtained by Neufeld and Snyder (Phys. Rev., 99: 1326(1955)). It is concluded that Ohmae and Hida did not take into account new developments in the theory of radiation damage. (DLC)

13224 EFFECT OF MINOR CONSTITUENTS ON SWELLING IN STAINLESS STEEL. Leitnaker, J. M.; Bloom, E. E.; Stiegler, J. O. (Oak Ridge National Lab., TN). J. Nucl. Mater.; 49: No. 1, 57-66(Nov 1973).

The small quantities of solute interstitial elements in stainless steel (C, N, and possibly Si) reduce the swelling under neutron irradiation (~2×10^{22} neutrons/cm^2) by more than an order of magnitude between 500 and 600°C over high purity material. The solute interstitials reduce both the numbers and sizes of irradiation-caused voids. Current swelling models ignore—of necessity—this gross effect. Several possible mechanisms are suggested to account for the effect. (3 tables, 3 figures, 28 references) (auth)

13225 GAMMA IRRADIATION-INDUCED CHANGES IN PRECIPITATES. Miura, K.; Fiore, N. F.; Allen, C. W. (Univ. of Notre Dame, IN). J. Nucl. Mater.; 49: No. 1, 108-112(Nov 1973).

A study was made to determine whether ^{60}Co γ rays will influence precipitate morphology in a commercial Al age-hardened alloy 2017 (~4% Cu), which has been heat treated to the fully hardened (T6) condition. Internal friction, electron microscopy, and x-ray diffraction were used. The significant results which were obtained, indicate that γ-irradiation cannot simply be dismissed as a cause of precipitate morphology change. (DLC)

13226 MECHANISM OF THE IN-REACTOR CORROSION OF ZIRCALOY. Asher, R. C.; Kirstein, T. B. A. (United Kingdom Atomic Energy Authority, Harwell, Eng.). J. Nucl. Mater.; 49: No. 1, 105-107(Nov 1973).

Post-irradiation oxidation experiments were carried out on Zircaloy-2 and -4 in liquid water at 340°C. Results for the previously irradiated samples show that post-irradiation oxidation is more rapid than in control unirradiated samples, but that the rate falls between that expected for in-reactor conditions and for out-of-reactor conditions. It is concluded that the radioinduced enhancement of corrosion in water is partly due to persistent radiation damage in the solid state, and partly due to transient radiolytic effects. (DLC)

13227 METHOD OF CALCULATING THE ACTIVATION ENERGY OF THERMALLY STIMULATED PROCESSES IN IRRADIATED SOLIDS. Baazov, D. I.; Glebov, D. V.; Kolbanovskii, Yu. A.; Polak, L. S. (Inst. of Petrochemical Processes, Baku). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 2, 112-117 (1973).

Translated from Khim. Vys. Energ.; 7: No. 2, 129-135(1973).

A method of calculating the kinetic parameters of thermally stimulated processes in irradiated solids is described. A critical review of the literature on this question is given. A new method of calculation is proposed in which the information obtained experimentally is used to the maximum extent and is substantiated in detail. The calculation of the activation energy and of the preexponential factor is performed by means of a computer. The use of the new method is illustrated for the case of experimental results on thermally stimulated exoelectronic emission. (auth)

13228 INVESTIGATION OF THE SWELLING BEHAVIOR OF SELECTED STAINLESS STEELS DURING HEAVY ION IRRADIATION. McDonald, S. G. III. Notre Dame, IN; Univ. of Notre Dame (1973). 130p. University Microfilms Order No. 73-24,328. Thesis (Ph. D.).

Void formation in liquid metal fast breeder reactor (LMFBR) structural components poses significant problems at high neutron doses due to the swelling and structural instabilities which accompany this process. Because high dose reactor exposures require very long irradiation times, the swelling behavior of candidate LMFBR structural materials has not been characterized at doses higher than 10^{23} neutrons/cm^2 (≈70 displacements/atom). Fortunately, these exposures can be reached in short times by the use of charged-particle bombardment. In this investigation, a series of austenitic stainless steels were irradiated with 4-MeV $^{58}Ni^+$ ions in order to simulate the high-dose exposures that will be encountered in full-scale LMFBR's. The swelling behavior of Type 304 was characterized as a function of ion dose at 600 and 525°C, while the swelling behavior of Type 316 was characterized as a function of ion dose at 525°C. Characterization included determination of mean void diameters, void number densities, void volume fractions, and dislocation densities. At 600°C, Type 304 swelled continuously with increasing dose, reaching void volume fractions of 0.5 or greater at 250 displacements/atom. At 525°C, Type 304 also swelled continuously with increasing dose, but void volume fractions were approximately an order of magnitude lower than those observed at 600°C. Type 316 exhibited swellings less than those observed in Type 304 at 525°C by about a factor of two. Two additional irradiations were carried out on ternary austenitic Fe–18Cr–Ni alloys to determine what affect Ni content had on void formation. These revealed that changes in Ni content of 10 wt % or less did not influence swelling behavior in austenitic Fe–18Cr–Ni alloys. Experimental results were compared with the theoretical predictions of a computer-based swelling code. This code was also used to evaluate the effects that intrinsic material parameters had on void formation. Both the experimental and theoretical swelling behaviors of the above alloys were shown to depend on the relative dislocation and void sink efficiencies present during irradiation. It was further concluded that computer modeling explained many of the phenomena observed during this series of irradiations. (Diss. Abstr. Int., B)

13229 INVESTIGATION OF INTERSTITIALS IN ELECTRON-IRRADIATED ALUMINUM BY DIFFUSE-X-RAY SCATTERING EXPERIMENTS. Ehrhart, P.; Schilling, W. (Institut für Festkörperforschung der Kernforschungsanlage Jülich, Jülich, Germany). Phys. Rev. B 8: No. 6, 2604-2621 (15 Sept 1973).

The diffuse scattering of x rays (Cu $K_{\alpha 1}$) from single crystals of aluminum has been investigated after low-temperature electron irradiation (defect concentrations 3×10^{-4} and 5×10^{-4}). The measurements were made near the (200), (400), (220), and (222) Bragg reflections in directions both parallel and perpendicular to the scattering vector. These measurements were repeated after a number of steps in an isochronal-recovery program. The data taken immediately after the irradiation showed all the characteristic features predicted by the theory for scattering from point defects with weak displacement fields (Huang scattering). The conclusions are the following: (i) The interstitial in Al has slightly tetragonal or cubic symmetry; the crowdion configuration can be excluded. (ii) By comparing the diffuse-scattering intensities with measurements of the lattice parameter the absolute defect concentration and the volume change ΔV per defect was determined ($\Delta V = 1.9 \pm 0.2$ atomic volumes per Frenkel defect.) From the absolute concentration and from electrical-resistivity change measurement on the same sample, the resistivity change was determined to be $\rho_F = 3.9 \pm 0.6$ μΩ cm per atomic percent Frenkel defects. In the recovery measurements an increase of the scattering intensity per defect was observed at the end of stage I. This gives direct evidence that the interstitials agglomerate during their free migration in stage I. In stage II a further increase of the scattering intensity per interstitial is observed close to the Bragg peaks, suggesting an increase of the average interstitial cluster size throughout this stage. The changes in the intensity distribution around the reflections were in good agreement with the predictions of the scattering theory for defects with strong displacement fields (Stokes–Wilson approximation). From the data, the mean number of interstitials per cluster can be estimated. It is 2 at the end of stage I and increases to about 10 at the beginning of stage III. There is good indication that the larger interstitial clusters are dislocation loops. (auth)

13230 PHONONLESS NEUTRON COOLING TO ULTRALOW TEMPERATURES. Namiot, V. A. (Scientific-Research Inst. for Nuclear Physics, Moscow). Dokl. Akad. Nauk SSSR; 211: No. 1, 76-78(1 Jul 1973). (In Russian).

Equations are presented that can be used to calculate the cooling of a neutron gas, in which energy lost by neutrons in cooling does not excite vibrations in the crystalline lattice. (TTT)

13231 INVESTIGATION OF RADIATION DAMAGE IN METALS IN A HIGH-VOLTAGE ELECTRON MICROSCOPE. Urban, K. Stuttgart, Ger.; Stuttgart Univ. (1972). 106p. (In German). Thesis.

The agglomeration of Frenkel defects that occur in nickel and

copper single crystals as a result of electron irradiation is studied. Under irradiation at large electron doses at 8°K, the formation of new types of contrasts was observed; these can be attributed to an unexplained form of defect agglomerates. It can be concluded that an agglomeration of defects is possible at low temperatures at which a far-reacting diffusion is not possible. Samples irradiated at 8°K show, under controlled heating in the microscope, characteristic changes of visible radiation damages at temperatures which can be correlated with the known recovery stages as shown by the electrical resistance. In the temperature range 300 to 810°K the formation of interstitial atom dislocation rings was observed. From 480°K upwards, vacancy agglomerates are also formed. These agglomerates are dislocation rings in high purity samples and, in samples containing gas impurities, are either stacking fault tetrahedrons or voids. The time and temperature dependence of the growth rate of the interstitial atom dislocation rings was quantitatively investigated. The defect concentrations which occur in thin metal sheets during irradiation at high temperatures were calculated. From the experimental observations, conclusions can be drawn about special nucleus formation conditions in thin sheets. The conditions for the formation of interstitial atom and vacancy agglomerates could be directly derived from the experimental results. These concepts are used in a model in order to calculate the temperature dependence of the growth rate of interstitial atom dislocation rings. A cryogenic object holder developed for the Hitachi microscope is described. The cooling system permits irradiation and simultaneous investigation in the microscope at temperatures between 8 and 300°K without affecting the optical resolving quality of the instrument. (GE)

Other Materials

Refer also to abstracts 12564, 12604, 12680, 13117–13119, 13121, 13155, 13156, 13164, 13215, 13227, 15100, 15124, 15126, 15127, 15159, 15161, 15168, 15172, 15174, 15176, 15177, 15193, and 15199.

13232 HIGH-STRENGTH AND LARGE-DIAMETER BORON FIBER. Jacob, B. A.; Douglas, F. C.; Galasso, F. S. (United Aircraft Corp., East Hartford, CT). Amer. Ceram. Soc. Bull.; 52: No. 12, 896-897(Dec 1973).

A 4-mil boron fiber was produced with an average strength of 657,000 psi and a high value of 1.2×10^6 psi. In the preliminary experiments, fibers were formed up to 20 mils. The improvements of the radio-frequency heated reactor have allowed the new developments in the production of the improved fibers. Fibers formed in the rf reactor show a complete absence of microstructure even for fibers with diameters up to the 20 mils. (MCW)

13233 NEUTRON FLUENCE AND ATOMIC DISPLACEMENT RATES FOR GRAPHITE IRRADIATIONS. Morgan, W. C. (Battelle–Pacific Northwest Labs., Richland, WA). Nucl. Technol.; 21: No. 1, 50-56(Jan 1974).

A brief review of the theoretical and practical bases for the correlation of graphite irradiation data obtained in different experimental facilities has been used in the derivation of relationships for conversion of the fluence units $\Phi_{(E>0.18\,MeV)}$ and $\Phi_{(DIDO\ eq.)}$, which have previously been most widely used for reporting graphite irradiation data, to the new international unit, Φ_C, "equivalent fission fluence for damage in graphite." Using the Thompson and Wright form of the atomic displacement function and the activation cross sections recommended by the International Nuclear Data Committee, with appropriate corrections for differences in cross sections used previously, the recommended conversion relationships are as follows: $\Phi_C = 1.18\ \Phi_{(E>0.18\,MeV)}$ and $\Phi_C = 1.77\ \Phi_{(DIDO\ eq.)}$. (auth)

13234 THERMOLUMINESCENCE AND X-RAY STIMULATED LUMINESCENCE OF CaF_2:Eu CRYSTALS. Ward, R. W.; Whippey, P. W. (Univ. of Western Ontario, London). Can. J. Phys.; 51: No. 4, 382-388(15 Feb 1973).

The x-ray luminescence and thermoluminescence due to Eu ions in CaF_2 were investigated. Thermoluminescent glow curves of CaF_2 single crystals containing several different concentrations of europium were measured between 4.2 and 400°K. Spectral analysis of the two major glow peaks at 92 and 240°K shows that the luminescence is due mainly to Eu^{2+} ions. The available evidence suggests the thermoluminescence of Eu^{2+} in CaF_2 is a hole-type recombination process similar to the generally accepted mechanism for thermoluminescence from trivalent rare-earth ions in CaF_2. In addition to the Eu^{2+} emission, lines are observed at lower energies in the x-ray luminescence spectra due to Eu^{3+} ions in at least three different symmetry sites. (auth)

13235 FORMATION OF VANADIUM SILICIDES BY THE INTERACTIONS OF V WITH BARE AND OXIDIZED Si WAFERS. Tu, K.N.; Ziegler, J.F.; Kircher, C.J. (IBM Thomas J. Watson Research Center, Yorktown Heights, New York 10598). Appl. Phys. Lett. 23: No. 9, 493-495 (1 Nov 1973).

Formation of vanadium silicides by the interactions of vanadium with bare and oxidized Si wafers has been studied by both x-ray diffraction and He ion backscattering techniques. X-ray diffraction was used to identify phases and ion backscattering to profile compositional changes. In the case of V on Si, the silicide VSi_2, which is a silicon-rich phase, was found to form at temperatures from 600 to 1000 °C. In the case of V on SiO_2, reactions took place only at temperatures above 800 °C, and the reaction products were identified to be V_3Si, V_5Si_3, and V_2O_5. Both V_3Si and V_5Si_3 are vandium-rich phases, and the V_3Si that we found was a continuous layer between the substrate and the other two phases, and became superconducting at about 15 °K. (auth)

13236 EPR STUDIES IN NEUTRON-IRRADIATED SILICON: A NEGATIVE CHARGE STATE OF A NONPLANAR FIVE-VACANCY CLUSTER (V_5^-). Lee, Y.-H.; Corbett, J.W. (Physics Department, State University of New York at Albany, Albany, New York, 12222). Phys. Rev. B 8: No. 6, 2810-2826 (15 Sept 1973).

EPR studies are carried out for the float-zone intrinsic silicon irradiated with reactor neutrons up to the total fluence 10^{18} n/cm^2. Details of the Si^{29} hyperfine structure and of the g tensor in the P-1 spectrum are observed with respect to temperature from 77 to 350 °K. The anisotropy of the g tensor and its continuous variation with temperatures are also discussed in terms of simple linear-combination-of-atomic-orbitals molecular orbitals and of the experimental results on the resonant wave function. In particular, the motional effect due to the electron-hopping between equivalent defect sites proposed by Nisenoff and Fan is not supported by these experiments, but an unusual thermal effect is observed in which the resonant-electron wave function is an average of both a ground and excited states, with the relative populations being proportional to the Boltzmann factor. The resonance properties of the pure ground state and pure excited state differ, which causes the g and A tensors to continuously vary with temperature and brings about a line broadening and narrowing in the hyperfine satellites as well as in the central lines. The line width broadening of the hyperfine lines is discussed on the basis that it is mainly due to transitions between the ground and excited electronic states. Based on the present results, a defect model for this center is established: a negative charge state of a non-planar five-vacancy cluster. (auth)

13237 POSITRON ANNIHILATION IN NEUTRON-IRRADIATED p-TYPE SILICON. Cheng, L.J. (Institute of Nuclear Energy Research, Atomic Energy Council, Lung-Tan, Tao-Yuan, Taiwan, Republic of China); Yeh, C.K.; Ma, S.I.; Su, C.S. Phys. Rev. B 8: No. 6, 2880-2886 (15 Sept 1973).

Effects of neutron irradiation and subsequent thermal annealing on positron-lifetime spectra in p-type silicon have been studied. In unirradiated samples, two annihilation rates (4.13×10^9 sec^{-1} with an intensity of 98% and 7.14×10^8 sec^{-1} with an intensity of 2%) are observed. The annihilation rate of the dominant component becomes smaller upon irradiation. The effect saturates at high integrated neutron flux, $\approx 1 \times 10^{17}$ n/cm^2, and disappears completely upon thermal annealing at 400-500 °C. The annealing behavior is dependent on the integrated neutron flux. These results show that some neutron-induced defects act as positron traps at room temperature. Our study also gives evidence that high-order vacancy defects are formed during annealing near 300 °C. The mean electron density of the positron-sensitive defects (positron traps) is estimated from the saturation value of the annihilation rate to be about 35% less than that in the perfect crystal. The diffusion coefficient and the mobility of thermalized positrons in silicon are estimated to be about 0.16 cm^2/sec and 6.4 cm^2/sec V, respectively. (auth)

13238 RELAXATION PROCESSES IN BORON. Tavadze, F. N.; Tsagareishvili, G. V.; Darsavelidze, G. S.; Tavadze, G. F.; Khachapuridze, R. A. (Inst. of Metallurgy, Tbilisi, USSR). (1973). vp.

From fifth international conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, Germany (27 Aug 1973).

Results of investigations of relaxation processes in β-rhombohedral boron by an internal friction method are presented. The experiments were carried out on films, plates, and cylindrical samples of zone-melted boron with purity not less than 99.9%. (GE)

13239 INVESTIGATION OF FORMATION CONDITIONS AND PROPERTIES OF THIN $CdIn_2Te_4$ FILMS. Paulavichus, A. B.; Yasutis, V. V.; Vesene, T. B.; Tolutis, V. B. (Semiconductor Physics Inst., Vilnyus, USSR). Liet. Fiz. Rinkinys; 13: No. 4, 561-567(1973). (In Russian).

The formation conditions and properties of thin films of $CdIn_2Te_4$

in the range of its homogeneity are reported. N-type electrical conductivity at 293°K of $10^{-3}\Omega^{-1}\cdot cm^{-1}$ and thermoemf coefficient of 300 300μ V/°K were determined. The Hall mobility at 394°K was 72 $cm^2\cdot V^{-1}\cdot s^{-1}$. The activation energy from electrical measurements was 1.44 eV and it was $\Delta E_{\gamma/2}$ = 11.20 eV from the spectral distribution of photoconductivity at 293°K. (auth)

13240 PROPERTIES OF MIXTURES OF BORON-CONTAINING BARIUM SERPENTINE CEMENT WITH CAST IRON POWDER. Kutateladze, K. S.; Egorov, Yu. A.; Zaalishvili, G. G.; Zenaishvili, N. V. (Tbilisi Scientific-Research Inst. of Construction Materials, USSR). Beton Zhelezobeton; No. 3, 28-29(Mar 1973). (In Russian).

A technology for the production of special radiation shields from boron-containing barium serpentine cement was developed. It was determined that the addition of cast iron powder to the cement in the proportion 1 : 1, 1 : 1.5, and 1 : 2 significantly increases the volume mass of the material, improves its shielding properties, and significantly reduces the shrinkage and decrease of the mechanical strength at increased temperature (up to 600°C). (tr-auth)

13241 MECHANISM OF ELECTRON-BEAM EFFECTS ON ORGANIC PHOTORESISTS. Neustroev, S. A.; Sokolov, E. B. (Moscow Inst. of Electronic Technology). Usp. Khim.; 41: No. 9, 1713-1734(Sep 1972). (In Russian).

A literature review is given on the decomposition of positive and negative photoresists under the action of actinic light and electron bombardment. The interaction of the electron current with other organic materials, metals, and inorganic dielectrics was examined. The internal irradiation mechanism of the resists was reduced to the fact that the electrons passing through the resist excites the molecules of the resists with subsequent luminescence and phosphorescence. The effect of the metallic and dielectric backing on the production of lines of necessary width was examined. It was shown that the crosslinking process of the negative photoresists under the action of an electron beam occurs by free-radical polymerization mechanism. (tr-auth)

13242 OXIDATION OF POCO AXF-Q1 GRAPHITE IN AIR. Segeletes, J. A. (Teledyne Isotopes, Timonium, MD). J. Spacecraft Rockets; 10: No. 12, 803-806(Dec 1973).

Results of an experimental program to determine the reaction rate and constant and reaction order of a fine-grain graphite POCO AXF-Q1 are presented. The reaction rate constant is determined to satisfy an Arrhenius-type equation for which the activation energy is 35,431 cal/mole and the effective collision frequency is 11,170 $lb/ft^2\text{-}sec\text{-}atm^{0.7}$. The reaction order is determined to be 0.7. The oxidation reaction equation that satisfies the test data is solved simultaneously with the oxidation diffusion rate equation to obtain oxidation rates as a function of surface temperature, pressure, and convective film coefficient. Solutions were obtained assuming the products of oxidation are either carbon monoxide or a mixture of carbon monoxide and carbon dioxide. Oxidation rates plotted as a function of temperature tend to have a plateau in the 2500 to 3500°R temperature range before approaching the conventional diffusion limited value. If a plateau is indeed realized, the oxidation rate is approaching a diffusion-limited value with carbon dioxide being the predominant product of oxidation. At higher temperatures, carbon monoxide becomes the predominant product, resulting in an increased oxidation rate that asymptotically approaches the conventional diffusion-limited value. A comparison is made between experimental data and the results of this study. The implications of this comparison are 1) carbon monoxide is the primary product of oxidation at moderate and high wall temperature; 2) chemical equilibrium is not always realized at the oxidizing wall. (auth)

13243 METHODS FOR CHARACTERIZING GRAFTED COPOLYMERS AND POLYOLEFINS. Munteanu, D. (Pitesti Petrochemical Industrial Group, Romania). Stud. Cercet. Chim.; 21: No. 8, 911-927(Aug 1973). (In Rumanian).

This state-of-the-art review discusses infrared spectroscopy, electron spin resonance, x-ray diffraction, electron microscopy, thermogravimetric and differential thermal analysis, chromatographic pyrolysis, and radio-thermoluminescent methods for studying polymers. (67 references) (TTT)

NUCLEAR MATERIALS AND WASTE MANAGEMENT

Accountability and Safeguards

Refer also to abstracts 12501 and 12820.

13244 (LA-5431-PR) NUCLEAR ANALYSIS RESEARCH AND DEVELOPMENT. Program Status Report, May–August 1973. (Los Alamos Scientific Lab., N. Mex. (USA)). Nov 1973. Contract W-7405-eng-36. 32p. Dep. NTIS $4.00.

Research progress during May to Sept. 1973 is reported on neutron interrogation and nondestructive assaying of nuclear fuels, fabricated fuel elements, and wastes from fuel reprocessing; monitoring of UF_6 enrichment; gamma ray analysis; instrumentation development, calibration standards, and measurement controls; and materials identification and analysis with stopped muons. (LCL)

13245 NON-DESTRUCTIVE ASSAY TECHNIQUES FOR NUCLEAR SAFEGUARDS MEASUREMENTS. Dragnev, T. (International Atomic Energy Agency, Vienna). At. Energy Rev.; 11: No. 2, 341-368(1973).

Three main aspects, important from the IAEA safeguards point of view, are briefly discussed: the role of nondestructive assay techniques (NDAT) in the IAEA safeguards system; a short description and comparison of NDAT, together with their present status from the point of view of their use in this system; and, finally, recent IAEA experience in the development and demonstration of these techniques under Agency field conditions. (auth)

13246 QUALITY CONTROL SAFEGUARDS FOR HTGR FUEL PRODUCTION. Disselhorst, B. F.; Carpenter, F. D.; Duffy, K. C. (Gulf General Atomic Co., San Diego, CA). Nucl. Mater. Manage.; 11: No. 3, 205-214(Fal 1973).

From proceedings of the 14th annual meeting of the Institute of Nuclear Materials Management, Inc.; San Diego, CA (20 Jun 1973).

The various sampling points and measurement techniques utilized at Gulf General Atomic for the safeguard and control of special nuclear materials during the production of High-Temperature Gas-Cooled Reactor fuel are discussed. The fuel production process is briefly described in order to emphasize the complexities associated with the selection of samples, sample points, and measurement techniques used in support of physical inventories. (auth)

13247 EFFECTS OF FALSE POSITIVES. Bennett, C. A. (Human Affairs Research Centers, Seattle). Nucl. Mater. Manage. 11: No. 3, 110-138(Fal 1973).

From proceedings of the 14th annual meeting of the Institute of Nuclear Materials Management, Inc.; San Diego, CA (20 Jun 1973).

One of the problems of making safeguards decisions based on material balance accounting or shipper-receiver differences is that there is always an unavoidable possibility that chance errors of measurement alone will lead to positive conclusions. This problems becomes particularly acute when system designs or inspection strategies involving a multiplicity of individual decisions are considered. The most important conclusion is that strategies based on cumulative indices, either over time or facilities, are likely to be less costly and more effective against certain alternatives than those based on more frequent individual decisions. While the timeliness implied by the latter is desirable, the illusion of effectiveness based on frequency alone should be avoided. (auth)

13248 CONSIDERATIONS ENABLING DYNAMIC INVENTORY IN FUEL CYCLE FACILITIES. Seefeldt, W. B.; Bean, C. H.; Bernstein, G. J. (Argonne National Lab., IL). Nucl. Mater. Manage.; 11: No. 3, 88-109(Fal 1973).

From proceedings of the 14th annual meeting of the Institute of Nuclear Materials Management, Inc.; San Diego, CA (20 Jun 1973).

Various methods of determining in-process inventory (holdup) without draindown and cleanout are presented. The uncertainties of in-process inventory measurements using a step (change in composition) in the feed of a low-enriched fabrication plant are analyzed. Propagated errors (2σ) of 0.6 to 1.8% were obtained for reference assumptions. Step size and errors in concentration assays were found to have pronounced influence on holdup uncertainties. The effects of product batch size and degree of in-process mixing, though less, were significant. Errors in weight measurements had small effects. The value of enrichment degradation was found to be about $250 for reference conditions for a plant with one metric ton holdup. The effects of step size and degree of in-process mixing on this value were significant. (auth)

13249 IS BALANCE CALIBRATION SUFFICIENT FOR DETERMINING WEIGHING UNCERTAINTIES. Post, R. I. (General Electric Co., San Jose, CA). Nucl. Mater. Manage.; 11: No. 3, 72-78(Fal 1973).

From proceedings of the 14th annual meeting of the Institute of Nuclear Materials Management, Inc.; San Diego, CA (20 Jun 1973).

In assessing measurement uncertainties, the problem of determining the operator error has received relatively little attention due to the difficulties involved. For example, how can the "true" operator error (his ability to use a measuring device) be separated from mistakes in recording or reporting data? The various problems are discussed and two solutions are suggested. (auth)

13250 FORMULATION AND VERIFICATION OF MATERIALS BALANCE PRO FORMA FOR A PLUTONIUM FUELS FABRICATION FACILITY. Nilson, R. (Exxon Nuclear Co., Inc., Richland, WA). Nucl. Mater. Manage.; 11: No. 3, 59-71(Fal 1973).

From proceedings of the 14th annual meeting of the Institute of Nuclear Materials Management, Inc.; San Diego, CA (20 Jun 1973).

The formulation and verification of a materials balance pro forma for the Exxon Nuclear plutonium facility is discussed. MUF experience falls within predicted values and is less than the 0.5% of material processed criteria proposed by the AEC for LE-MUF. For LE-MUF, optimism on measurement quality was not wholly born out with LE-MUF's higher than predicted. Nevertheless, the existent measurement quality indicates that a LE-MUF criterion of 0.5% can be met with current technology. Sampling variances between pellets is found to be a significant contributor to LE-MUF. (auth)

13251 APPROACH TO DETERMINING A SYSTEM OF ROUTINE INSPECTION EFFORTS AND TIMING FOR FABRICATION PLANTS. Takada, Y. (Mitsubishi Atomic Power Industries, Inc., Tokyo); Namba, K.; Iwamura, K.; Seki, Y.; Haginoya, T. Nucl. Mater. Manage.; 11: No. 3, 46-58(Fal 1973).

From proceedings of the 14th annual meeting of the Institute of Nuclear Materials Management, Inc.; San Diego, CA (20 Jun 1973).

The study was carried out to develop a system which determines routine inspection efforts and timing for fabrication plants. The inspection efforts are given to an individual fabrication plant by evaluating all its material balance data obtained in its past campaigns and all its processing programs in the coming year. On the other hand, the timing is determined by analyzing time-series data of MUFs. As a result of a sample calculation, the inspection efforts of less than 30 man-days per year have been obtained for a fabrication plant with a capacity of 100 TU LWR fuel per year. (auth)

13252 COMPUTERIZED NUCLEAR FUEL DATA BANK. Koncel, E. F. (Commonwealth Edison Co., Chicago). Nucl. Mater. Manage.; 11: No. 3, 41-45(Fal 1973).

From proceedings of the 14th annual meeting of the Institute of Nuclear Materials Management, Inc.; San Diego, CA (20 Jun 1973).

The computerized nuclear fuel data bank designed and being developed by Commonwealth Edison Company is described. It is expected that most of the system will be operational by the end of 1973. The primary function of the system will be one of accountability for the location and isotopic content of thousands of nuclear fuel assemblies that are owned and leased by Commonwealth Edison Company. In addition, the data bank will be used for such financial functions as the calculations of nuclear fuel expenses and the provision of a plant record for federal income tax calculations. All data will be available through a flexible retrieval program to develop special reports, to provide input for other computer programs, and to facilitate performing correlation studies. The nuclear fuel data bank will play a key role in nuclear fuel management. (auth)

13253 DYNAMIC INVENTORY: DREAM OR NECESSITY. Wilson, D. W. (Nuclear Materials Management, Morris, IL). Nucl. Mater. Manage.; 11: No. 3, 30-40(Fal 1973).

From proceedings of the 14th annual meeting of the Institute of Nuclear Materials Management, Inc.; San Diego, CA (20 Jun 1973).

The need for more frequent inventories of nuclear processing plants is being examined. In the past, sophisticated physical inventories requiring extended process shutdowns for cleanout and consolidation have been considered essential for effective inventory evaluation. However, frequent shutdown inventories

are not compatible with the high on-line efficiency rates required for economical operation of modern high capital cost fuel reprocessing plants. Systems are required where on-line dynamic measurement methods provide effective inventory information. At General Electric's Midwest Fuel Recovery Plant, efforts are underway to develop dynamic inventory techniques which will be compatible with regulatory, customer and operating requirements. The key requirements, concepts, goals and development areas involved in the MFRP dynamic inventory system are summarized. (auth)

13254 PRACTICAL APPLICATIONS OF ON-LINE DATA PROCESSING SYSTEMS TO MATERIALS CONTROL AND QUALITY ASSURANCE. Stewart, J. P.; Kane, J. W. (General Electric Co., Wilmington, NC). Nucl. Mater. Manage.; 11: No. 3, 180-186(Fal 1973).

From proceedings of the 14th annual meeting of the Institute of Nuclear Materials Management, Inc.; San Diego, CA (20 Jun 1973).

An on-line data acquisition system has been installed at GE's Wilmington fuel fabrication facility for use in materials control and quality assurance. A schematic description of the computer system is presented and the applications of such a system to materials control problems discussed. Included are descriptions of system-operator interactions and measurements taken, both within the hardware and software, to minimize data input errors. Materials Management benefits resulting from application of this type of computer system are presented. (auth)

13255 STATISTICAL CONSIDERATIONS IN THE DESIGN AND UTILIZATION OF HIGH SPEED FUEL ROD SCANNERS. Costello, D. G.; Gozani, T. (Intelcom Rad Tech, San Diego, CA). Nucl. Mater. Manage.; 11: No. 3, 187-204(Fal 1973).

From proceedings of the 14th annual meeting of the Institute of Nuclear Materials Management, Inc.; San Diego, CA (20 Jun 1973).

Important statistical aspects pertinent to high speed pellet-by-pellet rod scanners are discussed. The implications of these points on the design and more importantly on the application and usage of the rod scanner as an integral part of a fuel production plant are elucidated. (auth)

13256 PHYSICAL SECURITY: TODAY. Becker, R. C. (Univ. of California, Livermore). Nucl. Mater. Manage.; 11: No. 3, 215-217(Fal 1973).

From proceedings of the 14th annual meeting of the Institute of Nuclear Materials Management, Inc.; San Diego, CA (20 Jun 1973).

An aggressive, imaginative, and creative physical security program, incorporating the latest technology, should be a basic part of all programs for managing nuclear materials. At the Lawrence Livermore Laboratory some of the same tools and technology that are normally used to help solve scientific problems are being used. These systems include: computer access by individual numbers (CAIN), police alarm communications control (PACC), and broad-coverage television systems. These systems represent large initial capital investments, but the expenditures have been justified in terms of reduced operating costs and better security. These systems and their part in the overall security program are described. (auth)

13257 CONSIDERATIONS IN THE DESIGN OF A DOORWAY MONITOR. Martinez, J. L.; Cunningham, G. J. (Dow Chemical Co., Denver). Nucl. Mater. Manage.; 11: No. 3, 218-231(Fal 1973).

From proceedings of the 14th annual meeting of the Institute of Nuclear Materials Management, Inc.; San Diego, CA (20 Jun 1973).

Some of the considerations which must be given to the design and construction of a doorway monitor based upon two years of operational experience at Rocky Flats are described. Details such as detector selection, location of the monitor, necessary electronics, alarms, etc., are discussed. Those criteria are discussed in relation to such factors as the amount of safeguarding required, personnel throughput, and cost. (auth)

13258 INTERNAL CONTROL VIS-A-VIS DIVERSION PATH ANALYSIS. Murphey, W. A.; Schleter, J. C.; Maltese, M. D. K. (National Bureau of Standards, Washington, DC). Nucl. Mater. Manage.; 11: No. 3, 232-274(Fal 1973).

From proceedings of the 14th annual meeting of the Institute of Nuclear Materials Management, Inc.; San Diego, CA (20 Jun 1973).

A diversion path analysis procedure was developed for systematic analysis of diversion possibilities in plants using SNM. The procedure can be applied to diversion possibilities countered by physical protection and materials balance accounting but special emphasis is given to diversion possibilities in high throughput production areas. A parallel practicality study is discussed which used plant production data and had a working diversion indication objective of 500 and 24 h response for a single diversion of attractive material by a single employee without collusion given that the employee may alter any records to which he had access. Explanation of the procedure, its relation to plant internal control, relations or internal control data monitoring techniques to existing safeguards techniques and implementation implications are presented. (auth)

13259 ESTABLISHMENT OF A MATERIALS MANAGEMENT SYSTEM. Baranowski, F. P. (Atomic Energy Commission, Washington, DC). Nucl. Mater. Manage.; 11: No. 3, 275-291 (Fal 1973).

From proceedings of the 14th annual meeting of the Institute of Nuclear Materials management, Inc.; San Diego, CA (20 Jun 1973).

The establishment, organization, and functions of a nuclear materials management system within the USAEC are discussed. (TFD)

13260 DEVELOPMENT, TESTING, AND UTILIZATION OF THE ELEPHANT GUN FOR MEASUREMENT OF HETEROGENOUS RADIOACTIVE PROCESSING RESIDUALS. Vaughn, C. M.; Anstine, L. D.; Delap, J. S.; Stewart, J. P. (General Electric Co., Wilmington, NC). Nucl. Mater. Manage.; 11: No. 3, 292-319(Fal 1973).

From proceedings of the 14th annual meeting of the Institute of Nuclear Materials Management, Inc.; San Diego, CA (20 Jun 1973).

A nondestructive assay technique was developed for use at GE-Wilmington for the determination of the uranium and uranium-235 content of large (4′ × 4′′ × 4′) wooden crates. These wooden crates contain heterogeneous mixtures of combustible and non-combustible materials contaminated with low-enriched uranium. The assay technique is based on the passive signature of ^{234m}Pa, a ^{238}U daughter. A description of the physics mechanisms and method of routine operation is presented. The calibration technique is outlined and the experimental justification for assumptions is discussed. Error modeling is described and current error estimates stated. A summary is given providing illustrations for additional applications of this passive gamma technique for the assay of low-enriched uranium contained in other processing residuals, such as 55-gal drums and absolute filters. (auth)

13261 MEASUREMENTS OF UF_6 CYLINDERS WITH PORTABLE INSTRUMENTS. Walton, R. B. (Los Alamos Scientific Lab., NM); Reilly, T. D.; Parker, J. L.; Menzel, J. H.; Marshall, E. D.; Fields, L. W. Nucl. Mater. Manage.; 11: No. 3, 320-358 (Fal 1973).

From proceedings of the 14th annual meeting of the Institute of Nuclear Materials Management, Inc.; San Diego, CA (20 Jun 1973).

The applicability of portable instruments for rapid nondestructive verification of the enrichment of UF_6 in cylinders has been tested on a large number of types 30- and 5A-cylinders. Three basic techniques were used: gamma counting with NaI combined with ultrasonic measurement of cylinder wall thickness, passive neutron counting, and active neutron interrogation with thermal neutrons from a radioactive neutron source. The resulting accuracies and limitations of the techniques are presented. (auth)

13262 FIELD EXPERIENCE WITH NONDESTRUCTIVE TESTING EQUIPMENT. Lang, R. E. (Atomic Energy Commission, Argonne, IL). Nucl. Mater. Manage.; 11: No. 3, 359-370 (Fal 1973).

From proceedings of the 14th annual meeting of the Institute of Nuclear Materials Management, Inc.; San Diego, CA (20 Jun 1973).

Nondestructive analysis equipment used for nuclear safeguards at the USAEC's Chicago Operations Office is discussed. The equipment used includes a neutron well counter, a multi-channel analyzer, a single channel enrichment meter, an isotopic source assay system (ISAS), and an isotopic source assay fissometer (ISAF). (TFD)

13263 RECENT APPLICATIONS IN NUCLEAR MATERIALS ASSAY AND PROTECTION. Untermyer, S. II; Miller, H. (National Nuclear Corp., Redwood City, CA). Nucl. Mater. Manage.; 11: No. 3, 371-394(Fal 1973).

From proceedings of the 14th annual meeting of the Institute of Nuclear Materials Management, Inc.; San Diego, CA (20 Jun 1973).

Nondestructive analysis systems for assaying of bulk fuel, irradiated bulk fuel, and irradiated fuel rods are described. The use of door monitors to prevent diversion of strategic nuclear materials is also described. (TFD)

13264 METHOD FOR SURVEYING FOR URANIUM-235 WITH LIMIT OF ERROR ANALYSIS. Reed, W. D. Jr.; Andrews, J. P.; Keller, H. C. (Gulf General Atomic, San Diego, CA). Nucl. Mater. Manage.; 11: No. 3, 395-414(Fal 1973).

From proceedings of the 14th annual meeting of the Institute of Nuclear Materials Management, Inc.; San Diego, CA (20 Jun 1973).

A general method for surveying for ^{235}U using a portable single channel analyzer with a ½ in. × 1 in. NaI(Tl) crystal detector is presented. Surveys of plane surfaces, rectangular cavities, and cylindrical sources are described as examples of how the method is used. If thorium is present with the ^{235}U, a correction coefficient is derived that will eliminate the thorium contribution to the count rate. The statistical analysis of the data obtained from the survey method is described, and a procedure for determining the limit of error is outlined which includes nonuniform distribution of the ^{235}U, background, ratemeter counting errors, and the errors in the calibration coefficients. This survey method has been used successfully for determining the amount of ^{235}U holdup in ventilation duct work and a complex geometry incinerator system. (auth)

13265 VERIFICATION OF PLUTONIUM BEARING MATERIALS BY NONDESTRUCTIVE CALORIMETRIC ASSAY. Strohm, W. W.; Rodenburg, W. W. (Monsanto Research Corp., Miamisburg, OH). Nucl. Mater. Manage.; 11: No. 3, 415-431(Fal 1973).

From proceedings of the 14th annual meeting of the Institute of Nuclear Materials Management, Inc.; San Diego, CA (20 Jun 1973).

In early 1972 at the request of the Division of Nuclear Materials Security, 65 samples of plutonium were pulled from an AEC contractor inventory and shipped to Mound Laboratory for nondestructive plutonium analysis. A combination of calorimetry and gamma-ray techniques were used. Since then, over 100 additional analyses have been performed for the AEC/ALO and AEC/SAN Operations Offices. These samples have ranged from one to 2200 g of plutonium representing many different categories including mixed Pu-U oxides, metal, and several types of scrap and ash. Our experiences to date, as well as future directions, are presented. (auth)

13266 NONDESTRUCTIVE ASSAY MEASUREMENT STANDARDS: NEED AND APPROACH. Bishop, D. M. (General Electric Co., San Jose, CA). Nucl. Mater. Manage.; 11: No. 3, 432-442(Fal 1973).

From proceedings of the 14th annual meeting of the Institute of Nuclear Materials Management, Inc.; San Diego, CA (20 Jun 1973).

The current status of General Electric Company nondestructive assay $(Pu,U)O_2$ fuel standards is described. Industrial needs in the area of nondestructive assay measurement standards are identified. An industry wide program to provide mechanisms for certifying nondestructive assay physical standards and providing primary and secondary standards is proposed. (auth)

13267 GOVERNMENT-INDUSTRY PANEL ON MATERIALS AND PLANT PROTECTION REGULATIONS. Nucl. Mater. Manage.; 11: No. 3, 443-462(Fal 1973).

From proceedings of the 14th annual meeting of the Institute of Nuclear Materials Management, Inc.; San Diego, CA (20 Jun 1973).

Comments by AEC and nuclear industry representatives on the proposed changes in 10 CFR, Parts 70 and 73, Federal Register, Feb. 1, 1973 are presented. (TFD)

Disposal and Storage

Refer also to abstracts 12638, 12692, 12706, 12707, 12714, 12725, 12747, and 12749.

13268 (ARH-2757(Pt.2)) SUMMARY OF RADIOACTIVE SOLID WASTE BURIALS IN THE 200 AREAS DURING 1972. Anderson, J. D. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). 24 Apr 1973. Contract AT(45-1)-2130. 29p. Dep. NTIS $3.50.

The amount of radioactive materials that have been buried in the 200 areas during 1972 are summarized in tabular form. In addition to 1972, cumulative data since plant startup are given. (TFD)

13269 (BNWL-1758) OVERVIEW OF HIGH-LEVEL RADIOACTIVE WASTE MANAGEMENT STUDIES. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Aug 1973. 46p. Dep. NTIS $4.50.

Studies on waste fixation in low solubility silicate glasses and advanced disposal concepts for solidified high-level radioactive wastes at the Pacific Northwest Laboratory are reviewed. Waste disposal concepts being evaluated include geologic, seabed, ice sheet, extraterrestrial, and transmutation. (TFD)

13270 (HW-41535) UNCONFINED UNDERGROUND RADIOACTIVE WASTE AND CONTAMINATION IN THE 200 AREAS. Heid, K. R. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 17 Jan 1956. 40p. Dep. NTIS $4.00.

Declassified 11 Jan 1974.

Present knowledge about locations in the 200 Areas at Hanford, Wash. where radioactive wastes have been discharged to the ground is documented. The primary intent is to prevent future use of these sites for other purposes without knowledge of the existing contamination problem, not to determine whether the waste could contaminate the ground water. The Redox particle problem during 1954 has been omitted except where the concentration was sufficient to warrant posting the area as a radiation zone. Also, only those disposal sites within tank farms that were planned and scheduled have been included as the entire tank farm is now considered as having sufficient underground contamination to require monitoring for any excavating. (auth)

13271 DISPOSAL OF NUCLEAR WASTES. Kubo, A. S. (Army Corps of Engineers, Fort Leavenworth, KS); Rose, D. J. Science; 182: No. 4118, 1205-1211(21 Dec 1973).

The physical options which should be studied relative to the disposal of radioactive wastes from nuclear power plants, the technical advantages and disadvantages of each method, and the cost and benefits of different disposal methods are discussed. These options include: mausolea (engineered near-surface structures); disposal in mines, salt vaults, or continental ice sheets; in situ melt; and further chemical separation. It is concluded that at an increased, but modest cost these options can be explored and the outlook for successful radioactive waste management improved. (LCL)

Handling Equipment and Procedures

13272 (RFP-Trans-144) DESIGN OF TRANSPLUTONIUM LABORATORY WITH CIRCULAR ARRANGEMENT OF CELLS. Shvetsov, I. K.; Kosyakov, V. N.; Morozov, D. V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). [nd]. Translated from pp 535-545 of SM-125-23. (CONF-691008-20). 11p. Dep. NTIS $3.00.

From symposium on radiation safety problems in the design and operation of "hot" facilities; Saclay, France (13 Oct 1969).

The design of a hot laboratory for research work on transplutonium elements is discussed. Some alternative versions of the general layout of the hot part of the building are examined and a circular arrangement of 12 hot cells is proposed as the optimum version. The layout selected is an improvement on the usual linear arrangement in that the building is more compact and the maintenance area is relatively small. (auth)

13273 CRITICALITY STUDY OF FISSILE-METAL AND FISSILE-SOLUTION COMBINATIONS. Hunt, D. C.; Rothe, R. E. (Dow Chemical, Golden, CO). Contract AT(29-1)-1106. Nucl. Sci. Eng.; 53: No. 1, 79-92(Jan 1974).

In evaluating fissile-material recovery operations involving metal salvage immersed in a reagent, a criticality safety engineer must be able to identify systems of minimum critical mass. Further, he must know the effect on the reproduction factor caused by changes in process variables such as container size or the fissile concentration of the reagent. No new experimental results are reported but studies of the criticality aspects of fissile-metal immersion by analyzing the most applicable of the existing measurements are presented. The results are expressed in terms of the critical mass of the metal region (excluding the mass of fissile material in solution) as a function of the fissile concentration and dimensions of the liquid cylinder. The analysis indicates that the critical mass of practical combinations of uranium metal and uranium solution always exceeds that of an 18.7-g/cm^3, 93.2% ^{235}U-enriched uranium sphere centered in a 300-g/liter metal-water mixture. The corresponding conservative approximation for plutonium systems holds for a 19.7-g/cm^3, 95% ^{239}Pu sphere in a 200-g/liter metal-water mixture. The upper limit of applicability of these results is 500 g/liter for both plutonium and uranium systems. The calculational techniques described underestimate critical masses of uranium by ~5%; the calculated masses of plutonium are sufficiently overestimated to be conservative in practical applications. (auth)

13274 SUPPLE PROJECTION SHEATH AND DEVICE FOR THE ACCURATE POSITIONING OF THE OBJECT PROJECTED, INTENDED, IN PARTICULAR FOR CONTACT CURIE THERAPY. (to Commissariat a l'Energie Atomique, Paris). French Patent 2,234,214. 27 Apr 1971. 7p. (In French).

A flexible sheath for the projection of radioactive sources used

in contact Curie therapy is described. This sheath encloses a remote controlled cable motor, and has a joining part at its end, this joining part being connected to the flexible tube which encloses the object to be projected, the latter being attached in a movable manner to the cable. The sheath and cable constitute a movable assembly. (FR)

Transportation

13275 FILLING ALLOY. Wurm, J. G.; Heylen, P. R. (to EURATOM). Dutch Patent 7,110,751. 4 Aug 1971. (In Dutch). Available from the Commission of European Communities, Luxembourg.

The space between the can and the rods in a fuel element for a breeder reactor is, after irradiation, filled with an alloy with a melting point above 700°C. The rods cannot break during transportation to the reprocessing facility, and the cooling problem was solved. (EU)

13276 RADIATION SHIELDING MEANS JOINT. Backus, H. A. (to NL Industries, Inc.). US Patent 3,774, 037. 20 Nov 1973. Filed date 24 May 1971. 8p.

A pair of radiation shielding members to be joined include end portions provided with mechanical interlock portions. The joint means includes one or more joint members having cooperating mechanical interlock portions in the form of peripherally extending ribs and grooves for mechanically interlocking the pairs of shielding members with one another. The joint members are arcuate even when the radiation shielding members are not of circular cross-sectional configuration, as for example when the radiation shielding members define a plurality of apexes. (Official Gazette)

13277 RADIOACTIVE SHIPPING CONTAINER WITH NEUTRON AND GAMMA ABSORBERS. Anderson, C. J.; Peterson, R. W. (to National Lead Co.). US Patent 3,780,306. 18 Dec 1973. Filed Date 27 May 1971. 8p.

The shipping container includes inner and outer shells having gamma radiation shielding disposed between the shells. Neutron radiation shielding is disposed outwardly of the gamma radiation shielding. Heat conducting material is disposed in engagement with the outer shell and is interspaced with the neutron radiation shielding to conduct heat therethrough. (Official Gazette)

13278 INSULATED CONTAINER FOR RADIOACTIVE AND LIKE SUBSTANCES. Bochard, C. (to Robatel S. L. P. I.). US Patent 3,780,309. 18 Dec 1973. Filed Date 28 Jul 1970. 4p.

A double-walled container is described for radioactive material having an outer metal casing and an inner wall of lead and, in the space between the walls, an insulating material which is a solid mass of a mixture of hydrated alumina and hydrated iron oxide. The solid mass of insulating material may be formed in the space by pouring a mixture of an aqueous suspension of alumina trihydrate and particulate mild steel or iron into the space and allowing the mixture to set. The insulating material is effective in removing heat from the lead shield and in preventing heat reaching the lead shield from a source external of the container. (Official Gazette)

13279 SPENT FUEL HANDLING AND SHIPPING CAPABILITY. Collier, D. M. (Nuclear Assurance Corp., Atlanta). Nucl. Mater. Manage.; 11: No. 3, 18-29(Fal 1973).

From proceedings of the 14th annual meeting of the Institute of Nuclear Materials Management, Inc.; San Diego, CA (20 Jun 1973).

The capability of the industry to handle, ship, and store spent fuel is reviewed. Potential problem areas and the current industry status are examined in order to show the magnitude of each area and to point out what limitations, if any, are a result. In order to locate these potential problem areas, the industry is reviewed on a plant-by-plant basis; and the capabilities of each plant are compared to the requirements for each planned cask. (auth)

13280 PROBABILITY AND CONSEQUENCES OF TRANSPORTATION ACCIDENTS INVOLVING RADIOACTIVE-MATERIAL SHIPMENTS IN THE NUCLEAR FUEL CYCLE. Shappert, L. B. (Oak Ridge National Lab., TN); Brobst, W. A.; Langhaar, J. W.; Sisler, J. A. Nucl. Safety; 14: No. 6, 597-604(1973).

For 1980 the projected electrical generating capacity of nuclear power plants in the United States is about 130 MW(e); this, in turn, will generate thousands of shipments of radioactive materials annually. The probability of accidents involving these shipments within the public domain has been estimated and broken down into five severity categories. It is estimated that in 1980 the shipments considered would be involved in less than 20 accidents, most of which would result in only moderate damage to the shipping system and no significant nuclear-related hazards. An estimate was made of the effect of an extremely severe accident involving loss of contaminated coolant from a spent-fuel shipping cask and the possible exposure to the public. As a result of the estimates, it is concluded that the likelihood of any serious radiological injury is very small and the transportation of nuclear materials in the fuel cycle has a high degree of safety. (auth)

PARTICLE ACCELERATORS

Design, Development, and Operation

13281 (ANL-7996, pp 73-77) ACCELERATOR IMPROVEMENT. Feb 1973.

In chemistry division annual report, July 1971–June 1972.

A single "fine"-structure beam pulse containing 7nC of charge and 50 ps in time length ~150A amplitude available at the ANL LINAC is briefly described. Its energy can be varied over the range of about 4 to 20 MeV with accompanying energy spread of less than 300 keV. Repetition rate can range from one single pulse to 800 pulses/s. The beam can be delivered with its characteristics preserved to all the ports of the beam-transport system for both radiation chemistry and photoneutron experiments investigating the very short time reaction region. Important advances have been made toward establishing the feasibility of using a series of niobium helix resonators as the basic elements of a CW superconducting linear accelerator for heavy ions. The main questions about this structure are concerned with (1) the stability and reproducibility of its rf properties, (2) the control of rf-phase changes caused by mechanical vibrations, and (3) radiation damage of the superconductor. The results obtained to date are encouraging and suggest that there will soon be proven solutions to the major technical problems that might have blocked the construction of a superconducting linear accelerator for heavy-ion acceleration. (TFD)

13282 (BNWL-11) HANFORD AS A SITE FOR LARGE ACCELERATORS. Leonard, B. R. Jr. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jan 1965. Contract AT(45-1)-1830. 23p. Dep. NTIS $3.25.

The Ramsey Panel recommended that two very large accelerators be constructed during the next few years to meet urgent U. S. needs in high energy physics. Two studies have been made. The Lawrence Radiation Laboratory at Berkeley has studied a 200 to 300 BeV accelerator, while the Brookhaven National Laboratory on Long Island has made an analysis of a still larger accelerator—600 to 800 BeV. This special report is in response to a request for information on the suitability of the Atomic Energy Commission's Hanford Project as a site for a large accelerator. Using criteria recommended by Lawrence and Brookhaven, the Hanford site offers significant economic advantages both in original installed cost and in annual operating expense. These advantages are: (1) Land—Hanford has available more than 150 square miles of government-owned land that readily meets topographic, geologic, and seismic criteria; (2) Power—Hanford has surplus electrical capacity already installed to meet the demands of the largest accelerator—at the lowest rates in the U. S. This alone offers an annual savings of several million dollars over any other location; (3) Water—the Columbia River offers the largest supply of pure, cold water in the U. S.; there are excellent surplus reactor water plants available; (4) Transportation—four major railroads have direct connections to the Hanford Project rail system; multi-1000-ton barge service is also available; (5) Manpower—a high level of scientific and technical personnel as well as construction and craft labor is already in residence; (6) Services—complete support-type services, such as industrial shops, bus transportation, radiation protection, and plant security, are immediately available; and (7) Community—the area has an exceptionally high educational level, equal to the outstanding areas of the U. S. At the present time, the Hanford location has some disadvantages according to the cited criteria. These are: (1) lack of proximity to a university; (2) lack of a major jet airport; and (3) relative isolation from a major metropolitan area. The first two are even now under vigorous study and action by both state and local bodies. The third, though often a disadvantage, appears to have considerable appeal to many. In total, the many tangible assets of the Hanford Project offer tremendous potential dollar savings to the Government. The shutdown of production reactors makes many millions of dollars worth of excellent support facilities and manpower readily available. The minor disadvantages can be met almost entirely by the state and community. (auth)

13283 (KFK-tr-427) OUTLOOK FOR THE DEVELOPMENT OF NEW COLLECTIVE ACCELERATION METHODS. Rabinovich, M. S.; Tsytovich, V. N. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Experimentelle Reaktorphysik). Feb 1973. Translation of pp 92-99 from Symposium on Collective Methods of Acceleration. (CONF-720952-5). 10p. (In German). Dep. NTIS (U. S. Sales Only) $3.00.

From symposium on collective methods of acceleration; Dubna, USSR (27 Sep 1972).

The principal media for collective acceleration are plasmas and relativistic stabilized beams. Conditions for the use of the beam mechanism and the collision mechanism of the acceleration for collective acceleration in electron rings are theoretically derived. Relativistic solitons and non-linear waves as bunches for collective acceleration in plasmas are also considered theoretically. (JSR)

13284 (NP-19913) CONCERNING THE MECHANISM OF ELECTRON LOAD SUPPRESSION IN ACCELERATING TUBES DURING INCREASE OF RESIDUAL PRESSURE. Zheleznikov, F. G.; Bersenev, Ya. T. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1973. 30p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.50.

Data on the dark current suppression effect in tubes and the electron load initiated by these currents at residual pressures increasing from 10^{-6} to 10^{-5} to 10^{-4} torr in the vacuum system of an electrostatic accelerator are given. It is shown that the dark current suppression effect at increasing residual gas pressures is also observed in a simple diode system of electrodes. The suppression effect is caused by reversible and nonreversible changes of emissive capacity of dielectric microformations on cathode electrodes. The assumption of the microformation emission mechanism according to which the gas discharge is the source of electrons in microformation cells is substantiated. (auth)

13285 (NP-19914) MODIFICATIONS OF THE DESIGN OF A LINEAR INDUCTIVE ACCELERATOR. Vakhrushin, Yu. P. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1973. 23p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.25.

Expressions for the leakage, inductance and capacity for the basic modifications of the inductive system design are derived. The equivalent load resistance at the pulse front of the accelerating voltage is defined. On the basis of the obtained expressions and the simplified equivalent circuit of the accelerating system, expressions are derived for the voltage front pulse duration. The analysis of the main modifications of the inductive system design from the point of view of minimum front duration is given. The conclusion is made that the design modification should conform with the equivalent load value. (auth)

13286 INTERPRETATION OF SIGNALS ACQUIRED FROM CAPACITIVE PHASE PROBES IN AN ISOCHRONOUS CYCLOTRON. van Vliet, J. A. J. M.; Schutte, F.; Marchand, J. F. P.; Hagedoorn, H. L. (Univ. of Tech., Eindhoven, Netherlands). Nucl. Instrum. Methods; 113: No. 4, 527-533(1973).

Non-interceptive capacitive pick-up probes have been mounted in the vacuum chamber of the Eindhoven University of Technology A. V. F. cyclotron. With them the internal beam intensity and the HF phase angle with respect to the accelerating voltage phase angle are measured continuously. The dependence of the intensity and phase angle of the second harmonic component of the probe signals on deviations from isochronism is described. (auth)

13287 DESIGN AND PERFORMANCE OF A SMALL VAN de GRAAFF ACCELERATOR. Chatterjee, A.; Ganguly, A.; Ghosh, S. K.; Majumdar, N. K.; Mukherjee, S.; Saha, A.; Sarkar, R. (Saha Inst. of Nuclear Physics, Calcutta). Sci. Cult. (Calcutta); 39: No. 3, 136-140(Mar 1973).

The design and performance of a small single-ended horizontal Van de Graaff accelerator constructed at the Institute of Nuclear Physics, Calcutta, are described. (TFD)

13288 SUPERCONDUCTING MICROTRON: LOSSES, REFRIGERATION ENERGY, AND ORBIT CURRENT. Alaux, A.; Audet, J. C. (Univ. of Moncton, New Brunswick). Can. J. Phys.; 51: No. 5, 510-512(1 Mar 1973). (In French).

Superconducting cavities allow one to consider the c.w. operation of a microtron-type accelerator. Some of the theoretical results obtained are discussed. These results deal with the losses, the refrigeration energy, and the orbit current. (auth)

Auxiliaries and Components

13289 MEASUREMENT OF PROTON BEAM PROFILES. Hyman, L. G.; Jankowski, D. (Argonne National Lab., IL). Nucl. Instrum. Methods; 113: No. 2, 285-286(1973).

A simple and reliable method of making accurate proton beam profiles at accelerator energies is described. The profile is obtained by counting the proton-induced ^{24}Na activity which occurs when a proton beam strikes an array of aluminum rods. (auth)

13290 MULTIPLE SCATTERING AND FOCUSING OF CHARGED PARTICLES IN A MAGNETIZED IRON MEDIUM. Kartashev, V. P.; Kotov, V. I.; Rzaev, R. A. (Inst. for High Energy Physics, Serpukhov, USSR). Nucl. Instrum. Methods; 113: No. 2, 287-293(1973).

The behavior of charged particle beams with arbitrary primary distribution in media of magnetized iron with axially symmetric and transverse homogeneous fields is considered on the base of the kinetic equation. The results are applied to a complicated system, consisting of sections of such a medium, separated by free intervals. (auth)

13291 LIFETIME OF CARBON FOILS USED AS HEAVY-ION STRIPPERS. Yntema, J. L. (Argonne National Lab., IL). Nucl. Instrum. Methods; 113: No. 4, 605-607(1973).

A procedure for increasing the lifetime of carbon foils used as electron strippers for energetic heavy ions is described. The foils are heated to a temperature in the vicinity of 500°C and the temperature gradients and charge concentrations in the foil are decreased by a slow motion of the foils. With this procedure, lifetimes in excess of 2 h are obtained for 3-MeV $^{58}Ni^{+}$ beams with 1 $\mu A/mm^2$. (auth)

13292 MEASUREMENTS OF ISR BEAM PROFILES WITH A SPARK CHAMBER-COUNTER TELESCOPE. Amendolia, R. (Univ., Pisa, Italy); Bechini, A.; Bellettini, G. pp 397-401 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

The Pisa–Stony Brook Collaboration has measured the proton–proton total cross-section at the ISR by a simultaneous determination of the beam–beam interaction rate and the machine luminosity. The luminosity is proportional to the overlap integral of the two beam profiles. This integral has been obtained using the beam displacement (Van der Meer) method. The Van der Meer method was checked by measuring individual beam and beam–beam profiles with a spark chamber-counter telescope. The individual beam profiles were obtained by evaporating titanium and detecting beam-titanium scattering events. Also, the ISR beam displacement scale was measured with the spark chamber telescope. (auth)

13293 MEASUREMENT OF THE FLIGHT TIME OF NEUTRAL PARTICLES USING THE RF STRUCTURE OF THE BEAM. Jones, R. E. H.; Duerdoth, I. P.; Wynroe, A. J. (Univ. of Manchester, Eng.). pp 402-404 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

A time-of-flight (TOF) system developed at Daresbury to measure the flight time of neutral K mesons from a beryllium production target to an interaction target of liquid hydrogen in the experimental area at a distance of 20 m is described. The time of the interaction in the hydrogen was obtained from a hodoscope of counters situated around the target. The electrons in NINA were accelerated in phase stable buckets by rf cavities operating at 407.9 MHz. But for this experiment only alternate phase stable buckets were filled with electrons giving a spacing of 4.9 ns between the bunches of electrons. The time the K^0's were produced was directly related to the timing of the electron bunches and could be measured to modulo 4.9 ns by recording the phase of the 204 MHz rf structure of the electron beam. A resonant idler cavity mounted coaxially on the NINA vacuum ring provided a rf signal related to the electron density of the circulating beam. This was 20% amplitude modulated (AM) by the ring fill factor and had an overall dynamic range from 8 to 0 volts. Two further complications were that for ~9 ms, each acceleration cycle there was no rf and in order to maintain optimum operating conditions frequency shifts ~40 kHz were applied to the NINA rf. The effect of the AM was removed by measuring the phase of the constant amplitude output of a local oscillator phase locked to the cavity voltage. (auth)

13294 BEAM SCANNER FOR A 1 MeV VAN DE GRAAFF. Carra, W.M.; Ehret, J.E.; Locker, D.R. (Aerospace Research Laboratories, Wright-Patterson Air Force Base, Ohio 45433); Meese, J.M. Rev. Sci. Instrum. 44: No. 9, 1407-1408 (Sept 1973).

An electron beam scanner is described which is used to produce uniform scans and steering of the electron beam from a 1 MeV Van de Graaff accelerator during electron radiation damage experiments. (auth)

13295 SINGLE-PULSE INTEGRATOR. Miller, A. (Danish Atomic Energy Commission, Risoe). Nucl. Instrum. Methods; 114: No. 1, 189-191(1974).

A single-pulse integrator is described. It gives a relative measure of the integral of the output signal from a coil monitor on the Risφ 10-MeV linear accelerator, and displays the value on a digital voltmeter. The reproducibility is found to be better than ±1% for an accelerated pulse charge larger than 6.5×10^{-3} As. The linearity is better than ±5%. (auth)

13296 EXPERIMENTAL METHODS FOR MEASURING THE OPTICAL PARAMETERS OF A BEAM LINE. Reeve, P. A. (Univ. of Victoria, B. C.); Robertson, L. P.; Al-Qazzaz, N. M.; Ingram, C. H. Q. Nucl. Instrum. Methods; 114: No. 1, 105-112 (1974).

Some novel and some conventional methods of setting up foci, measuring linear magnification, and dispersion using scintillation counters and spark chambers are discussed. Some experimental and theoretical results are compared for a particular pion beam line. (auth)

13297 DEVICE FOR DETERMINATION OF CHARGED PARTICLE BEAM PROFILE AND POSITION. Prudnikov, I. A.; Toropov, A. S.; Chichikalov, Yu. F.; Khokhryakov, I. V. (Scientific Research Inst. of Electrophysical Apparatus, Leningrad). Nucl. Instrum. Methods; 114: No. 1, 101-104(1974).

Design features and characteristics of a device for determining the charged particle beam profile and position are discussed. The device is based on scanning the beam with a thin metal probe. Profile distortions, which result from the fact that the probe traverses the beam in a circular arc while the oscilloscope scanning is linear, are estimated. It is shown that, with the monitor having $r/R = 0.5$ (r is the beam radius and R is the probe rotation radius), distortions are less than 2.5%. (auth)

Ion Sources and Injection and Extraction Systems

13298 DESIGN, CONSTRUCTION, AND PERFORMANCE OF THE ENERGY COMPRESSING SYSTEM OF THE MAINZ 300 MeV ELECTRON LINAC. Herminghaus, H.; Kaiser, K. H. (Johannes-Gutenberg Univ., Mainz). Nucl. Instrum. Methods; 113: No. 2, 189-194(1973).

For the sake of better energy resolution of the 300-MeV electron linac of Mainz University, a system has been built which transforms a sharply bunched beam of poor energy resolution into a beam of sharply defined energy, while its bunches are smeared out. The system is described, its design philosophy and some essential construction details are given. The operating experience of the last 6 months since completion of the system is communicated. (auth)

13299 HOLLOW DISCHARGE DUOPLASMATRON AS A NEGATIVE HYDROGEN ION SOURCE. Sluyters, T.; Prelec, K. (Brookhaven National Lab., NY). Nucl. Instrum. Methods; 113: No. 2, 299-301(1973).

Preliminary results are reported on a hollow discharge duoplasmatron for the production of negative hydrogen ions. A beam current of more than 5 mA was extracted. (auth)

13300 NOTE ON HIGH RESOLUTION MEASUREMENTS WITH A TANDEM ACCELERATOR. Bilpuch, E. G. (Duke Univ., Durham, NC); Purser, F. O.; Moses, J. D.; Hayward, T. D.; Newson, H. W.; Mitchell, G. E.; Outlaw, D. A.; Nelson, R. O. Nucl. Instrum. Methods; 113: No. 4, 603-604(1973).

The installation of a direct extraction negative ion source has led to significant improvements in high resolution measurements with a tandem accelerator. The intensities of both the experimental and associated (control) proton beams have increased by an order of magnitude; the overall measured resolution was improved to 425 eV. (auth)

13301 PERFORMANCE OF HOT-CATHODE HEAVY-ION SOURCE INSTALLED IN A 2 MV VAN DE GRAAFF ACCELERATOR. Denimal, J.; Gasser, H.; Ricaud, C. (Centre de Recherches Nucleaires, Strasbourg). Nucl. Instrum. Methods; 114: No. 1, 93-99(1974).

A heavy-ion source which has been installed in the terminal of the Strasbourg 2 MV Van de Graaff accelerator is described. This diode source operates with a total power dissipation of 350 W. The beams obtained include $^{12}C^{+}$(0.8μA), $^{14}N^{+}$(1μA), $^{16}O^{+}$(0.4μA), $^{20}Ne^{+}$(8.5μA), $^{22}Ne^{+}$(0.85μA), N_2^{+}(6μA), $^{35}Cl^{+}$(1.4μA), $^{37}Cl^{+}$(0.45μA), $^{40}Ar^{+}$(1.8μA), as well as $^{28}Si^{+}$(0.06μA) and $^{28}Si^{++}$(0.065μA) from silane by means of a differentially pumped gas stripper. (Unless otherwise stated all the values given in this article have been measured with a secondary electron repeller.) (auth)

13302 REMARKS ABOUT THE EXTRACTION SYSTEM OF THE AEG COMPACT CYCLOTRON. Liesem, H. (Gesellschaft

fuer Strahlen- und Umweltforschung, Frankfurt am Main). Nucl. Instrum. Methods; 114: No. 1, 165-167(1974).

Extraction calculations for the AEG compact cyclotron are described, and the phase space pattern for precessional extraction of protons is discussed. (auth)

Ion Optics and Field Calculations

13303 TOROIDAL CONDENSER. I. Calculation to Any Order of the Electrostatic Potential. Dolduc, L.; Baril, M.; de Celles, M. (Univ. Laval, Quebec). Nucl. Instrum. Methods; 113: No. 2, 225-234(1973).

A systematic way of obtaining the electrostatic potential to any order from given boundary conditions is presented for the general toroidal condenser having a plane symmetry. All the recurrence relations for the coefficients of its power series expansion are explicated in matrix form and a simple algorithm results for their calculation. The validity of the expansion is also examined. (auth)

13304 TOROIDAL CONDENSER. II. Distribution in the Plane of Symmetry: the Equipotentials—the r^{α} Case. Bolduc, L.; Baril, M.; de Celles, M. (Univ. Laval, Quebec). Nucl. Instrum. Methods; 113: No. 2, 235-240(1973).

A way of calculating the electrostatic potential in a general tore from a given distribution in the plane of symmetry is exposed. The potential being known in the tore, any equipotential is obtained as an expansion the coefficients of which can be successively determined. The case of an r^{α} potential in the plane of symmetry leads to hypergeometric expansions in spherical coordinates and to simple equations readily amenable to computation for the equipotentials. (auth)

Storage Rings

Refer also to abstracts 12881 and 12896.

13305 (BNL-18395) STOCHASTIC COOLING IN GENERAL AND ITS APPLICATION TO $\bar{p}$ STORAGE IN PARTICULAR. Palmer, R. B. (Brookhaven National Lab., Upton, N.Y. (USA)). 15 Oct 1973. 6p. Dep. NTIS $3.00.

Some basic formulae for stochastic cooling are presented. The formulae are not exact but suffice to get order of magnitude results. (auth)

13306 (LNF-73-32) DATA ACQUISITION SYSTEM FOR THE ADONE CONTROL ROOM. De Simone, S.; Lauta, V.; Matera, M.; Ricci, C.; Tazzari, S.; Vignola, G. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 18 Jun 1973. 24p. (In Italian). Dep. NTIS (U. S. Sales Only) $3.25.

The data acquisition system for the Adone control room is described from the viewpoint of the functions specifically required for particular applications. The system is designed on the assumption of the possibility of high noise and the necessity for absolute reliability in data transmission. (JSR)

13307 PULSED ELECTROSTATIC QUADRUPOLE FOCUSING FOR THE CERN MUON STORAGE RING. Flegel, W.; Krienen, F. (CERN, Geneva). Nucl. Instrum. Methods; 113: No. 4, 549-560 (1973).

In order to improve the precision in the measurement of the g-factor anomaly $a = (g-2)/2$, it is desirable to have the polarized muons circulating in a uniform magnetic field ($B \cdot v = 0$). Vertical focusing of the muons can be done with an electrostatic quadrupole field. Although the required potentials on the electrodes are reasonable (~40 kV), the combined action of magnetic and electric field considerably enhances the probability of breakdown. This is due to trapped electrons which circulate around the electrodes and ionize the molecules of the rest gas. However, with reasonable vacuum ($<10^{-6}$ torr) the build-up of charge is slow. Therefore a pulsed electrostatic quadrupole field is applied, the field being on during the storage time of the muons, i.e. 1 ms. In this way the system is operational. (auth)

13308 PLUTO, A 4π-DETECTOR FOR DORIS. Criegee, L.; Franke, G.; Lohrmann, E.; Mehrgardt, H.; Timm, U.; Waloschek, P.; Willutzki, H. J.; Winter, G.; Zimmermann, W. (DESY, Hamburg). pp 707-710 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

The detector consists of 14 cylindrical proportional chambers, placed concentric to the storage ring axis of DORIS (Double Orbit Intersecting Storage ring of DESY), and a ring of scintillation counters, which are accommodated inside the superconductive solenoid coil of the magnet. The magnet produces a 20 kT homogeneous field parallel to the e^+e^--beams. The axial field integral is compensated by outside coils. Plane proportional chambers are inserted in slits of the magnet yoke to detect muons. The system employs 20,000 channels for signals from wires and high voltage stripes. Trigger modes and momentum resolution are discussed. (auth)

13309 FOCUSING OF THE CERN MUON STORAGE RING. Krienen, F. (CERN, Geneva). pp 732-738 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

The polarized muons circulate in a uniform magnetic field. Vertical focusing of the muons is achieved with an electrostatic quadrupole field. The combined action of magnetic and electric field enhances considerably the probability of breakdown. This is due to trapped electrons which circulate around the electrodes and ionize the molecules of the rest gas. However, with reasonable vacuum ($<10^{-6}$ torr) the build-up of charge is slow. Therefore, a pulsed electrostatic quadrupole field is applied, the field being on during the storage time of the muons, i.e., 1 ms. In this way the system is operational. (auth)

Experimental Facilities

Refer also to abstracts 12830, 12846, 12847, 12851–12854, 12887, 12897, 12901, and 12936–12938.

13310 (BNL-18335, pp 131-146) K^- BEAMS AVAILABLE NOW AND IN THE FUTURE. Palevsky, H. (Brookhaven National Lab., Upton, NY). 1973.

From conference on nuclear and hypernuclear physics with kaon beams; Upton, New York (2 Jul 1973).

In proceedings of the summer study meeting on nuclear and hypernuclear physics with kaon beams.

The characteristics of major K^- beam installations are reviewed in order to give some idea of what fluxes are presently available and to try to understand what might be available in the not too distant future (JFP)

13311 (BNL-18362) BLIP: THE BROOKHAVEN LINAC ISOTOPE PRODUCER PROGRAM. Lebowitz, E.; Richards, P.; Stang, L. G. Jr. (Brookhaven National Lab., Upton, N. Y. (USA)). [nd]. 21p. (CONF-730849-2). Dep. NTIS $3.25.

From summer study group on practical applications of accelerators; Los Alamos, New Mexico, USA (27 Aug 1973).

The BLIP serves as a beam stop and utilizes the excess beam capacity of the 200-MeV proton injector linac for the Alternating Gradient Synchrotron. The primary objective of the BLIP program is the development of improved radiopharmaceuticals. The production methods for iron-52, xenon-127, and xenon-123 are outlined, and research work on the production of other radioisotopes is summarized. (WHK)

13312 (LBL-2149) REPORT ON LOS ALAMOS PION FACILITY (LAMPF). Crowe, K. M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1973. Contract W-7405-eng-48. 16p. (CONF-730471-1). Dep. NTIS $3.00.

From intermediate energy physics meeting; Zuoz, Switzerland (13 Apr 1973).

The status of LAMPF is reviewed, and the experimental areas are briefly discussed. The experimental areas include the Energetic Pion Channel and Spectrometer (EPICS), Low-Energy Pion Channel (LEP), Stopped Muon Channel, Pion and Particle Physics Channel (P^3), Nucleon Physics Laboratory (NPL), High-Resolution Proton Spectrometer (HRS), Nuclear Chemistry, and the Neutrino Facility. (WHK)

13313 AN ISOTOPE SEPARATOR ON-LINE SYSTEM AT A CYCLOTRON FOR HEAVY IONS (PINGIS). Fransson, K.; Ugglas, M. A.; Engstroem, A. (Research Inst. for Physics, Stockholm). Nucl. Instrum. Methods; 113: No. 2, 157-168(1973).

An isotope separator for on-line operation at the 225-cm cyclotron in Stockholm has been constructed for studies of nuclides far from the line of β stability and produced by heavy-ion reactions. Its ability to prepare mass separated samples suitable for nuclear spectroscopy has been demonstrated for both neutron-rich and neutron-deficient nuclides. The equipment was tested in June 1969 by the separation of known mercury isotopes produced by (α,xn) reactions on platinum. The major part of the work has involved

studies of separated products from α-particle induced fission of uranium. The beam of heavy ions extracted from the cyclotron is focused on a solid target inside the separator ion source. The nuclear reaction products are continuously released and ionized in the discharge chamber at high temperatures. Beams of electromagnetically separated nuclides are collected in front of various radiation detectors. A detector arrangement suitable for coincidence measurements on very short-lived isotopes is described as well as a tape transport system for the collected radioactive samples. The temperature of the target-ion source (1500°C) has permitted the separation of a large number of elements produced in fission. The most short-lived nuclides so far observed are $^{120}Ag^{m}(T_{\frac{1}{2}} = 0.3$ s) and $^{96}Rb(T_{\frac{1}{2}} = 0.2$ s). (auth)

13314 FIRST OPERATION RESULTS OF THE RF-SEPARATED BEAM AT IHEP. Bernard, P.; Chodirev, I. S.; Galjaev, N. A.; Grant, A.; Kotov, V. I.; Lazeyras, P.; Lengeler, H.; Marechal, B.; Prelaz, J. C.; Prillepin, A. A.; Prossin, B. V.; Zelenin, V. E. (CERN, Geneva). Nucl. Instrum. Methods; 113: No. 2, 295-298(1973).

The results of the first operation of the rf-separated beam at IHEP, in conjunction with the Saclay bubble chamber Mirabelle, are given. The parameters of the beam and of the separator are also summarized. (auth)

13315 MECHANICAL SAMPLE SWEEPING SYSTEM FOR LARGE SURFACE IRRADIATION. Lazarski, S.; Maydell-Ondrusz, E.; Drwiega, M. (Inst. of Nuclear Physics, Krakow). Nucl. Instrum. Methods; 113: No. 2, 303-304(1973).

In order to achieve the possibility of large surface irradiation, a mechanical sample sweeping system was constructed. The device is based on two asynchronic motors equipped with two reversing clutches and an electronic control system. (auth)

13316 POLARIZED PHOTON BEAM PRODUCED BY COHERENT PAIR PRODUCTION IN ORIENTED GRAPHITE. Eisele, R. L. (Stanford Univ., CA); Sherden, D. J.; Siemann, R. H.; Sinclair, C. K.; Quinn, D. J.; Rutherfoord, J. P.; Shupe, M. A. Nucl. Instrum. Methods; 113: No. 4, 489-507(1973).

Attenuation by coherent pair production in highly oriented, compression annealed, pyrolytic graphite has been used to polarize a 16-GeV bremsstrahlung beam. The polarizer consists of 61 cm of graphite crystals, whose reciprocal lattice vectors are oriented at 10.5 mrad to the normal to the beam direction, and can be rotated by 90° about the beam line to rotate the plane of polarization. A functionally identical assembly of length 30.5 cm was used as an analyzer to measure the polarization of the beam with the SLAC pair spectrometer. The beam produced intensities greater than 4×10^5 equivalent quanta per beam pulse and had a measured polarization of 0.255 ± 0.020. (auth)

13317 ROTATING TARGET ASSEMBLY FOR THIN TARGETS. McFadden, R. C.; Martin, P. W. (Univ. of British Columbia, Vancouver). Nucl. Instrum. Methods; 113: No. 4, 601-602(1973).

The design of a rotating target system is described which is both simple and readily compatible with most types of scattering chambers. The performance of deuterated polyethylene targets enclosed between carbon layers is reported. (auth)

13318 GRAVITY OPERATED RECOIL TRANSFER SYSTEM. Archer, J. K.; Natowitz, J. B. (Texas A and M Univ., College Station). Nucl. Instrum. Methods; 113: No. 4, 609-610(1973).

A system with which reaction recoils caught on aluminum leaf catchers at the reaction site are transferred to the counting site by gravity is briefly described. The technique allows a reproducible high collection efficiency and rapid (<1 s) transfer. (auth)

13319 PERFORMANCE OF A HIGH-PRESSURE, HIGH-BEAM-CURRENT GAS TARGET. Carlson, J. D. (Ohio Univ., Athens). Nucl. Instrum. Methods; 113: No. 4, 541-543(1973).

A low-mass, small-volume gas target which utilizes O-rings for mounting the entrance window is described. The target is intended as a neutron source using the $D(d,n)^3He$, $T(d,n)^4He$ and $T(p,n)^3He$ reactions. The performance of the gas target with respect to gas pressures and beam intensities is discussed. (auth)

13320 EXPERIENCE WITH SUPERCONDUCTING MAGNETS FOR POLARIZED PROTON TARGETS. Desportes, H. (CEN de Saclay, Gif-sur-Yvette, France). pp 445-447 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

A large variety of superconducting magnets have been designed and constructed for polarized proton targets. Among those currently operating for physics, two significant examples are the Saclay "Hera" Magnet and the Argonne PPT III magnet. The experience obtained with these two magnets is briefly reviewed as an illustration of the possibilities offered by such new systems. (auth)

13321 USE OF THE FOCUS SYSTEM TO MONITOR AN EXPERIMENT AT THE CERN INTERSECTING STORAGE RINGS. Gerard, J. M.; Hansroul, M.; Palandri, E. M.; Palazzi, P.; Zanella, P. (CERN, Geneva). pp 507-511 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

The practical experience gained in the regular use over more than one year of the CERN developed FOCUS system, to monitor the performance of an experiment by making available the full power of the CERN central computers for on-line analysis of sample data, is reported. (auth)

13322 DARESBURY ON-LINE SYSTEM. Sherman, H. J.; Daniels, T.; Peatfield, A. C.; Richmond, P. M.; Zacharov, B. (Daresbury Nuclear Physics Lab., Eng.). pp 512-515 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

The on-line system at the Daresbury Nuclear Physics Laboratory is described with emphasis on the users view-point. The system comprises an IBM 370/165 in communication with many small on-line computers which form an integral part of experiments. The system facilitates not only data collection and monitoring but also data storage and sample analysis on the central computer. The advantages of this mode of working are discussed. (auth)

13323 DATA ACQUISITION AND HANDLING FOR DUBNA SYNCHROCYCLOTRON EXPERIMENTS. Medved, S. V.; Sinaev, A. N. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 516-518 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

A system for acquisition and handling data obtained in experiments at the Dubna synchrocyclotron is described. Various multichannel and multi-parameter analyzers, wire chambers, etc. are the source of data. The data from these devices enter one of the 6 storage 4096-channel units. On ending the chosen exposure the stored data are transferred to the HP-2116C computer for handling. After initial setting the proper working modes and program the whole process is accomplished automatically without any experimenter's participation. The block diagram of the apparatus and the flow chart of the program are given. If it is necessary to perform complicated mathematic processing, the data from the 2116C computer are transferred through the cable line to the BESM-6 computer. (auth)

13324 PROBLEMS AND FEATURES OF HIGH ENERGY BEAMS FOR MULTI-HUNDRED GeV ACCELERATORS. Brianti, G.; Brown, K. L.; Placci, A. (CERN, Geneva). pp 655-664 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

The basic features of multi-hundred GeV beams such as particle production and acceptance, identification and rejection and their impact upon the beam design optimization are reviewed and discussed. Typical beam characteristics for various types of particles are given along with their particular design problems. Examples of existing NAL beams and some possible CERN SPS beams are included in the discussion for illustration. (auth)

13325 HIGH ENERGY BEAM AND THE rf-SEPARATOR FOR BEBC AT THE CERN-300 GeV. Atherton, H.; Bernard, P.; Grant, A.; Lazeyras, P. (CERN, Geneva). pp 711-715 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

A rf separated beam for BEBC using a target located in the epb tunnel at the maximum distance from BEBC is described. As it has been shown that BEBC is a useful detector for strong interaction physics up to the 100 GeV/c region of incident momenta, it is intended that the beam will separate masses to the highest possible momenta (73 GeV/c K-π), that are a reasonably clear

extension of present techniques. It is also intended to give the first part of the rf beam in the epb tunnel the capacity to transport the major part of the available proton flux to the West Area to provide a secondary target for a short neutrino beam or a lower energy separated beam installed on the floor of halls E1 and E3. The maximum unseparated momentum is 150 GeV/c. (auth)

13326 STATUS REPORT ON THE SUPERCONDUCTING rf-SEPARATION WORK AT KARLSRUHE. Bauer, W.; Citron, A.; Dammertz, G.; Grundner, M.; Lengeler, H.; Rathgeber, E. (Univ., Karlsruhe, Ger.). pp 716-720 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

At Karlsruhe a superconducting rf-separator is under construction which is foreseen to be used from 1976 onwards at the CERN 300-GeV proton synchrotron. It will separate particles up to at least 30 GeV/c. A summary of the measurements on some test-deflectors is given. Results on rf-joints and tuners are presented. Multi-periodic deflectors have been computed and the implications for separation at higher particle energies are discussed. (auth)

13327 USE OF SUPERCONDUCTING MAGNETS ON 400 GeV BEAM LINES. Kircher, F.; N'Guyen, S. V.; Parain, J. (CEN, Saclay, France). pp 721-725 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

The possibility of using superconducting magnets on primary and secondary beam lines is studied both physically and economically. After a short recall about the cost of the magnets, their use on primary beam lines is shown to reduce length and total cost. Applications on secondary beam lines where a strong field is necessary are given: the use of superconducting magnets allows to reduce length, increase acceptance and to remove particles from the direct beam line. (auth)

13328 SOME ASPECTS OF TARGETTING FOR NEUTRINO EXPERIMENTS. Ball, A. E. (CERN, Geneva). pp 726-730 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

The general layout of the present CERN neutrino facility is described briefly. The fast ejected proton beam has been redesigned so as to provide separated function control on beam position, direction and profile at the target, and some new monitoring devices have been incorporated. This has greatly simplified operation and, together with other improvements in the system, has contributed to an increased and symmetrically distributed neutrino flux. These features are discussed and related to the design of the neutrino facility on the 400 GeV SPS accelerator. The higher energy and intensity raise considerable problems in the design of the target and local shielding; some possible solutions are proposed. (auth)

13329 DEUTERON STRIPPING AT 6 BeV/c AND PRODUCTION OF A TAGGED NEUTRON BEAM. Leemann, C.; Mehlhop, W.; Grunder, H.; Piccioni, O.; Bowles, P.; Thomas, R.; Scipione, D.; Garland, R.; Sebek, J. pp 731 of 1973 International Conference on Instrumentation for High Energy Physics. Stipcich, S. (ed.). Frascati, Italy; Comitato Nazionale per l'Energia Nucleare (1973).

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973). See CONF-730531-.

We have obtained and investigated a neutron beam from a stripping target bombarded by 6 BeV/c deuterons at the Bevatron. In the forward direction, practically all stripped neutrons are high energy ones, and they have a momentum spread of ±3% for a uranium target, ±3.5% for beryllium. We also obtained a neutron beam tagged by the protons which accompany the neutrons. For those tagged neutrons, the momentum resolution was better than ±.7%. The process of tagging is in all probability mostly due to Coulomb interaction. (auth)

13330 IMPROVEMENTS IN OR RELATING TO NEUTRON GENERATORS. Stark, D. S. (to National Research Development Corp.). British Patent 1,325,685. 8 Aug 1973. Filed date 23 Dec 1969. 6p.

Reference is made to neutron generators of the type having a sealed-off envelope or tube in which D and/or T ions from an ion source are accelerated to strike a target containing D and/or T to produce neutrons by the D-D and/or D-T reactions. In generators containing T a problem arises from the decay of T to ^{3}He, leading to a continuously increasing concentration of ^{3}He in all parts of the tube containing T. Since ^{3}He is chemically inert it is not chemically bonded to the apparatus in the same way as its parent T, and there is thus a gradual release of ^{3}He, that builds up a gas pressure in the free space within the tube. This free ^{3}He gas can cause reduction of neutron output in several ways. The object of the arrangement described is to alleviate the problem of ^{3}He accumulation. A pump is provided for removing He from the generator envelope, this pump being adapted to pump gas from the envelope when operated, and not to substantially absorb hydrogen gas from the envelope when not operated. The pump is preferably of the sputter-ion type, having a sputterable electrode system, the sputterable metal having a low chemical affinity for hydrogen, and a high sputtering coefficient for the ions. The pump is preferably of the triode type, and may be external to the envelope and permanently sealed thereto. Suitable sputterable metals included Cu, Ag and Au deposited on a stronger metal such as stainless steel, monel, or Mo. The pump serves to remove accumulated gaseous ^{3}He periodically. Before switching on the hydrogen isotope replenisher the pressure in the table is checked, a reading other than zero indicating the presence of He; the pump is then operated until a zero indication is obtained. The pump is then switched off and the replenisher operated to give the working hydrogen isotope pressure. Details are given of the hydrogen isotope replenisher. (UK)

13331 IMPROVEMENTS TO SAFETY EQUIPMENT AND IN PARTICULAR EQUIPMENT USED IN CONJUNCTION WITH RADIATION MONITORS. Perraudin, C. (to Thomson-CSF). French Patent 2,133,318. 16 Apr 1971. 7p. (In French).

Safety equipment intended to be used in conjunction with radiation monitors is described. The invention concerns, principally, radiotherapy, but can apply to all circumstances involving rigorously controlled irradiation (medical research or treatment of products in view of their preservation) derived from x-ray generators or particle accelerators. Two devices detecting the quantity of energy produced by a source are each connected to an associated measuring unit, each unit being connected across the input of a corresponding comparator one of which is associated with a reference source. The outputs of the units and the comparators are coupled respectively to switches connected in series in an emergency energy source shut-down unit, the opening of this circuit being actuated by the exceeding of a particular predetermined magnitude. (FR)

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

Cosmic Radiation

Refer also to abstracts 12763, 12893, 12906, 12943, 13604, 13817, 13836, and 13961.

13332 ANALYSIS OF A MODEL FOR TRANSPORT OF CHARGED PARTICLES IN A RANDOM MAGNETIC FIELD. Hanson, F. B. (Univ. of Illinois, Chicago); Klimas, A.; Ramanathan, G. V.; Sandri, G. J. Math. Anal. Appl.; 44: No. 3, 786-798(Dec 1973).

A model for the transport of charged particles in a random magnetic field is a Volterra integrodifferential equation with a long-range kernel. The integrodifferential equation is solved numerically with the method of Bellman, Kalaba, and Lockett ("Numerical Inversion of the Laplace Transform," Elsevier, New York, 1966). The results are shown to be in excellent agreement with analytical asymptotic results. (9 figures) (auth)

13333 OBSERVATION OF COSMIC-RAY PARTICLES WITH Z > 35. Blanford, G.E. Jr.; Friedlander, M.W.; Klarmann, J.; Pomeroy, S.S.; Walker, R.M.; Wefel, J.P. (Laboratory for Space Physics, Washington University, St. Louis, Missouri 63130); Fowler, P.H.; Kidd, J.M.; Kobetich, E.J.; Moses, R.T.; Thorne, R.T. Phys. Rev. D 8: No. 6, 1707-1722 (15 Sept 1973).

Tracks of very heavy cosmic-ray particles have been recorded in nuclear emulsions and several different types of plastic detectors exposed during two high-altitude balloon flights in September 1968. Based on a total of 113 tracks, the following flux values have been derived for kinetic energies > 1 GeV/nucleon: $J(35 \leq Z \leq 40) = (16 \pm 4) \times 10^{-6}$ particles/m²sr sec, $J(41 \leq Z \leq 50) = (28 \pm 6) \times 10^{-6}$ particles/m²sr sec, $J(51 \leq Z \leq 60) = (9 \pm 2) \times 10^{-6}$ particles/m²sr sec, $J(61 \leq Z \leq 70) = (1.8 \pm 0.7) \times 10^{-6}$ particles/m²sr sec, $J(71 \leq Z \leq 85) = (3 \pm 1) \times 10^{-6}$ particles/m²sr sec, $J(Z \geq 86) = (1.0 \pm 0.6) \times 10^{-6}$ particles/m²sr sec. The well-established presence of particles with $Z \geq 86$ requires a cosmic-ray source in which the r process of nucleosynthesis has been effective. The relative abundances over the charge region $(51 \leq Z \leq 85)$ show agreement with solar-system abundances, but there appear to be significant departures for the two lower-charge groups. Calibration of the detectors and experimental problems are also discussed. (auth)

13334 OBSERVATION OF COSMIC-RAY PARTICLES WITH Z > 50 AND INTERPRETATION OF THE CHARGE SPECTRUM. Blanford, G.E. Jr.; Friedlander, M.W.; Klarmann, J.; Walker, R.M.; Wefel, J.P. (Laboratory for Space Physics, Washington University, St. Louis, Missouri 63130). Phys. Rev. D 8: No. 6, 1722-1729 (15 Sept 1973).

Large areas of plastic detectors and nuclear emulsions were exposed to the primary cosmic radiation on two high-altitude balloon flights in May 1968 and September 1969. From measurements on the tracks found in the scanning of the plastic detectors, events with charges Z > 50 were selected, and these data were consolidated with those from our earlier flights. Several conclusions can be drawn from the observed charged spectrum. The detection of trans-bismuth nuclei confirms earlier observations of these particles in the cosmic rays. However, no trans-uranium particles were observed. Detailed features of the charge spectrum cannot be explained by nuclei from r-process nucleosynthesis alone. Although the addition of particles following s-process abundances yields improved agreement, the spectrum appears more complicated than would result from a simple combination of r- and s-process abundances with identical propagation histories. (auth)

13335 COSMIC RAYS AND MAGNETIC STARS. Havnes, O. (Univ. of Oslo). Astron. Astrophys.; 24: No. 3, 435-440(May 1973).

In an earlier paper (Havnes, 1971 b), rotating magnetic stars which accelerate ionized interstellar gas particles were suggested as possible cosmic-ray sources. The relative cosmic-ray abundance from such sources should depend on the ionization state of the interstellar gas as it encountered the rotating magnetic field of the star. This ionization state is computed for a number of stellar temperatures representative of the magnetic stars. The average ionization state of the different elements is in good agreement with the corresponding primordial cosmic-ray abundance. An exception is hydrogen which is less abundant in the primordial cosmic rays than is indicated by its ionization state in the interstellar gas near the magnetic stars. Possible explanations for this discrepancy in connection with the acceleration process are discussed. (auth)

13336 SECONDARY ELECTRONS AND ENERGY PER ION-PAIR IN A THERMAL GAS FOR ELECTRON, PROTON, AND X-RAY IONIZATION. Bergeron, J.; Collin-Souffrin, S. (Observatoire de Paris, Meudon, France). Astron. Astrophys.; 25: No. 1, 1-8(May 1973).

The total number of electron-ion pairs Φ produced by the complete absorption of an electron beam, in a pure hydrogen gas, is determined as a function of the electron energy and of the ionization degree of the gas. The average energy necessary to produce such an ion-pair is simply deduced from Φ. Ranges from 4 I_H (Ryd unit) to 800 I_H for the electron energy, and from 0.1 to 10^3 for the ratio of atomic hydrogen to electronic densities are covered. The efficiency of secondary electrons in further ionizations, ϕ_{sec}, is then given. The results for ϕ_{sec} apply also to a range of proton beam energy running from 1 to 25 MeV. The asymptotic maximum value for ϕ_{sec} is equal to 0.64 and is reached only for primary electron energy larger than 10^3 I_H (or proton energy >25 MeV), and for a neutral medium with an atomic hydrogen to electronic density ratio greater than 10^3. The mean heating energy available per primary electron is found to be simply related to Φ. The minimum heating energy available per ionization is reached in the case of a neutral medium. It varies very slowly with the primary electron energy and is equal to 4.7 eV for energy of 10^2 I_H. The presence of heavy elements does not introduce great changes in the numerical results. (auth)

13337 VARIATION OF COSMOGENIC Kr AND Xe IN A CORE FROM ESTHERVILLE MESOSIDERITE: DIRECT EVIDENCE THAT THE LUNAR ^{131}Xe ANOMALY IS A DEPTH EFFECT. Kaiser, W. A.; Rajan, R. S. (Univ. of California, Berkeley). Earth Planet. Sci. Lett.; 20: No. 2, 286-294(Oct 1973).

Kr and Xe were measured by a stepwise heating technique in three samples of a drill core in the "Minnesota" fragment of the Estherville mesosiderite. The cosmogenic ^{78}Kr/^{83}Kr decreased from the "top" sample to the "bottom" sample ("top" = 0.163 ± 0.005, "bottom" = 0.151 ± 0.005) while the cosmogenic ^{131}Xe/^{126}Xe ratio increased ("top" = 5.58 ± 0.35, "bottom" = 6.92 ± 0.17). Cosmic-ray track studies have shown that the "top" sample was indeed closer to the pre-atmospheric surface than the "bottom" sample by ~10 cm. This is the first direct evidence, in a sample of known geometry, that the cosmogenic ^{131}Xe/^{126}Xe ratio increases as a function of depth, and as such, confirms the hypothesis that the lunar ^{131}Xe anomaly is a bona fide depth effect due to resonance neutron capture in ^{130}Ba. (auth)

13338 MUON CONTRIBUTION TO DEVELOPMENT OF ELECTRON–NUCLEUS SHOWERS GENERATED BY COSMIC RAYS. Knyazev, A. F.; Kosarev, V. B.; Khrenov, B. A.; Yarochkina, Z. V. (Moscow State Univ.). Yadern. Fiz.; 18: No. 4, 837-843(Oct 1973). (In Russian).

The results are presented of a study of the absorption of electron–nucleus showers generated at sea level by cosmic-ray particles under the absorber depth of 1.65 ± 20 λ_{in}, where λ_{int} is a nucleon interaction range. The experimental set-up consisting of four spark chambers and two scintillation counters allowed the electron–nucleus showers with an energy E ≥ 10 GeV generated in carbon target to be separated. The obtained results agree with the expected number of electron–nucleus showers generated by the hadron and muon compounds of cosmic rays. The contributions from the muon and hadron components are compared at the absorber thickness X ~ 5 λ_{in}. (auth)

13339 INTENSITY OF COSMIC MUONS AT LARGE ROCK AND WATER DEPTHS AND THE MUON ENERGY SPECTRUM AT SEA LEVEL. Vavilov, Yu. N.; Trubkin, Yu. A.; Fedorov, V. M. (Lebedev Inst. of Physics, Moscow). Yadern. Fiz.; 18: No. 4, 844-853(Oct 1973). (In Russian).

Starting with different assumptions on cosmic-ray muon energy spectrum at sea level the Monte-Carlo calculation of muon absorption curves at large water and rock depths are made using modern ideas of muon interaction with water at high energies. The results of calculations are compared with the data on muon absorption in the soil of Colar Gold Fields and with the authors' measurements of muon absorption in water. (auth)

13340 MUONS IN EXTENSIVE AIR SHOWERS (INTERACTION WITH MATTER). Il'ina, N. P.; Khrenov, B. A.; Yarochkina, Z. V. (Moscow State Univ.). Yadern. Fiz.; 18: No. 4, 854-864(Oct 1973). (In Russian).

The experimental data on interaction of muons from extensive air showers (EAS) are presented. The data were obtained at an underground depth of 40 m w.e. by means of spark chambers sliced with lead. The Moscow University arrangement for studying EAS which includes muon detectors made it possible to determine the number of particles in EAS and the distance from the EAS axis of muons undergoing interaction. The probability of muon electromagnetic interaction is presented as a function of a distance from the EAS axis. This dependence is used to estimate the mean muon

energy at various distances from the EAS axis. There have been observed several acts of electromagnetic interactions of muons with the matter of the experimental arrangement. These results were used to estimate the upper limit of the flux of EAS muons with energy $\geq 10^3$ GeV. The data are obtained on the number of penetrating showers generated by EAS muons in the soil above the experimental arrangement. The obtained data on the underground interactions of EAS particles give no indication that the observed particles differ from muons. (auth)

13341 POSITRONIUM ORIGIN OF 476 keV GALACTIC FEATURE. Clayton, D. D. (Rice Univ., Houston, TX). Nature (London) Phys. Sci.; 244: No. 139, 137-138(27 Aug 1973).

Reference is made to the findings of Leventhal (to be published in Astrophys. J.) regarding a galactic feature at 476 ± 24 keV. Leventhal calculates that an observed peak in the positronium spectrum will lie at 490 keV. The present author calculates that if the positronium spectrum lies atop a steeply falling continuum due to other sources then the apparent peak can fall near 476 keV, where it was observed, and shows that explosive nucleosynthesis is a plausable source of the positrons. Furthermore the actual data on the observed feature look like a positronium feature. The primary sources of positrons from supernova explosive nucleosynthesis could be ^{56}Co, the progenitor of ^{56}Fe with a half-life of 77d, and ^{44}Sc, the daughter of 48 yr ^{44}Ti and progenitor of ^{44}Ca. Either or both could be the source of sufficient positrons to account for the observed feature. (UK)

13342 ENERGY AND ZENITH ANGLE DEPENDENCE OF ATMOSPHERIC MUONS. Maeda, K. (CERN, Geneva). Fortschr. Phys.; 21: No. 3, 113-154(1973).

The recently proposed new process for energetic-muon production in the atmosphere should be tested at Mt. Chacaltaya, where the atmospheric muons with longest paths in the atmosphere can be observed. For the sake of comparing the experimental results with those of usual atmospheric muons, rigorous calculations of zenith-angle distribution of atmospheric muons were made for the altitude of 5200 m above sea level with energy range from 100 GeV to 100 TeV, and for zenith angles from 0 to 92.3°. Calculations are based on the extension of the Chapman function to the case of a nonisothermal atmosphere, taking into account (i) energy-dependent nuclear-interaction mean free path of cosmic-ray hadrons in air, (ii) different magnitudes of photonuclear cross section in the energy-loss process of muons in the atmosphere, (iii) contributions of atmospheric muons arriving below the horizontal directions, and (iv) atmospheric structure and geomagnetic deflection. Results are compared with those corresponding to sea level. Range straggling, particularly its effect on horizontally incident muons, is investigated by Monte Carlo calculation, indicating that its effects and that of (i) on the zenith-angle-dependence of high-energy atmosphere muons are negligible. (auth)

13343 ABUNDANCE OF SECONDARY NUCLEI IN COSMIC RAYS. Kegel, W. H. (Univ., Heidelberg). Astron. Astrophys.; 26: No. 2, 287-290(Jul 1973).

According to Juliusson et al. (1972), the abundance of secondary nuclei in cosmic rays above 30 GeV/N decreases with increasing energy. In order to interpret this result, three different hypotheses are discussed. a) The low-energy particles are stored more effectively than the high-energy particles in a region of increased density near the source (supernova shell). This model requires that the low energy particles are accelerated in an early stage (10. . .100 years) of the expansion of the supernova shell. b) The diffusion through interstellar space is energy dependent. This model requires fluctuations of the interstellar magnetic field of rather small scale lengths. c) The low-energy particles are confined for an appreciable time in or near the solar system. This model requires unrealistic long confinement times and/or a very high density of interplanetary dust. While it seems that the last supposition can be ruled out, it is difficult, at present, to estimate the relative importance of the two other effects. (auth)

13344 ORIGIN OF COSMIC RAYS. Ginzburg, V. L.; Syrovatskii, S. I. Topics in Astrophysics and Space Physics. New York; Gordon and Breach, Science Publishers, Inc. (1969). 67p.

This book is based on a lecture course prepared for the summer school at Les Houches in 1966. Included is an article by Ginzburg and Syrovatskii from the 10th International Conference on cosmic Rays at Calgary (1967). (WDM)

13345 OBSERVATION OF LOW ENERGY COSMIC RAY PARTICLES ABOVE SYOWA STATION, ANTARCTICA. Tami, E.; Sakai, T.; Narita, N.; Ogura, K.; Kogami, S. (Nihon Univ., Narashino, Japan). Nihon Daigaku Seisan Kogakubu Hokoku; 5: No. 1, 135-138(Mar 1972). (In Japanese).

In order to study solar modulation mechanism operating on cosmic-ray particles by observing long-term time variation of low-energy cosmic rays, protons and helium nuclei components were observed by balloon-borne detectors at Syowa Station, Antarctica, situated on high latitude, 1970. The flux of protons and helium nuclei observed in this experiment is reported. Also, the flux of the neutral component above Syowa Station is described. (auth)

13346 NOBLE GAS CONCENTRATIONS AND COSMIC RAY EXPOSURE AGES OF EIGHT RECENTLY FALLEN CHONDRITES. Bogard, D. D.; Reynolds, M. A.; Simms, L. A. (National Aeronautics and Space Administration, Houston, TX). Geochim. Cosmochim. Acta; 37: No. 11, 2417-2433(Nov 1973).

Abundances and isotopic compositions of He, Ne, Ar, and Xe have been measured in eight recently fallen chondrites. Ratios of concentrations of cosmic ray-produced ^{3}He, ^{21}Ne, ^{22}Ne, and ^{38}Ar indicate that all eight samples experienced less than average cosmic-ray shielding. ^{3}He and ^{21}Ne exposure ages were calculated using shielding corrected chondritic production rates and the measured ^{22}Ne/^{21}Ne. Exposure ages calculated from ^{22}Na/^{22}Ne and ^{26}Al/^{21}Ne ratios and constant relative production rates show a bias between the two ages due to variations in ^{22}Na/^{26}Al. Arguments are presented that this bias is due to irradiation hardness differences, and therefore the use of constant values for both the ^{22}Na/^{22}Ne and ^{26}Al/^{21}Ne production ratios is not permitted. Dwaleni, Swaziland, was found to be an unusual gas-rich chondrite with high concentrations of solar-derived He and Ne and planetary-type Xe. (auth)

13347 THREE-DIMENSIONAL COSMIC RAY ANISOTROPY IN INTERPLANETARY SPACE. III. Origin of Cosmic Ray Solar Semi-Diurnal Variation. Nagashima, K.; Ueno, H.; Fujimoto, K.; Fujii, Z.; Kondo, I. (Nagoya Univ., Japan). Rep. Ionosphere Space Res. Jap.; 26: No. 1-2, 1-30(Jun 1972).

Annual modulation of cosmic-ray daily variation, observed by ion-chambers at Cheltenhan and Christchurch, were studied in order to determine the anisotropy responsible for the solar semi-diurnal variation of cosmic rays. So far, two hypotheses have been proposed for the explanation of the anisotropy. One is called the density gradient hypothesis which assumes the existence of cosmic-ray density gradient in the direction perpendicular to the ecliptic plane as a result of diffusion process. The other is called the pitch-angle distribution hypothesis which assumes a specific form of cosmic-ray pitch-angle distribution against the interplanetary magnetic line of force as a result of a particle's spiral motion along the direction. Although cosmic-ray space distributions, predicted from these hypotheses, are different from one another, they each produce semi-diurnal variation similar to the other's. Therefore, they cannot be discriminated from each other by observing simply the semi-diurnal variation. In order to determine the origin of the semi-diurnal variation, it is required to observe a "special" diurnal variation, characterizing these anisotropies. Different from the "usual" diurnal variation, the "special" variation shows a strange behavior that, in spite of its finite daily amplitude, its yearly average becomes very small or zero as a result of its annual modulation due to the Earth's revolution around the Sun. Because of this nature, it is necessary to observe the annual modulations of the "special" diurnal variation for the determination of the origin. The present analysis of the annual modulation will give some decisive evidence which will lend support to the pitch-angle distribution hypothesis. (auth)

13348 FORBUSH PREDECREASE. Gold, R. E.; Peacock, D. S. (Univ. of Denver). J. Geophys. Res.; 78: No. 4, 577-587 (1 Feb 1973).

Forbush decreases observed by superneutron monitors are frequently preceded by an almost equally large predecrease. Five such events are studied here, and there are two main observational results: (1) the predecrease represents a cosmic-ray depletion in a narrow range of pitch angles (±30°) around the mean interplanetary field direction and (2) the predecrease has an unusual rigidity dependence inasmuch as its amplitude increases with rigidity, going something like $R^{0.5 \to 1.5}$ up to a limit of about 80 Gv. Both these results can be accounted for by a model of the interplanetary magnetic field that generates the Forbush decrease and the predecrease by way of a propagating disturbance from the Sun. Using Barnden's (1971) work, it appears that such a model requires cosmic-ray mean free path that increases with rigidity according to $R^{1 \to 3}$. (auth)

Stars

Refer also to abstracts 13335, 13499, 13605, 13633, and 13666.

13349 (EP-RR-32, pp 55-62) LABORATORY MODELLING OF STELLAR PHOTOSPHERE RADIATION FIELDS. Logan,

P. F.; Stalker, R. J. (Australian National Univ., Canberra). Oct 1972.

From plasma physics seminar-1972 meeting; Canberra, Australia (9 Mar 1972).

As a means to allowing the radiative effects associated with phenomena occurring in stellar photospheres to be studied in the laboratory, the requirements for producing a steady nozzle flow of plasma with a radiation field similar to that of a stellar photosphere are discussed. It is shown that the basic requirement, namely, optical opacity to continuum radiation in the nozzle reservoir region, can be achieved in a high performance shock tunnel. A spectrum of a radiating nozzle flow obtained under such conditions is shown. (auth)

13350 (N-73-31754) RELATIVISTIC STELLAR STABILITY: PREFERRED-FRAME EFFECTS. Ni, W. T. (California Inst. of Tech., Pasadena (USA)). 1973. 15p. (NASA-CR-135517). NTIS $3.00.

Possible preferred-frame effects on stellar stability were examined and no new instabilities were found. In particular, it is shown that: (1) Although terms linear in the preferred-frame velocity w (time-odd terms analogous to viscosity and energy generation) change the shapes of the normal modes, their symmetry properties prevent them from changing the characteristic frequencies. Thus, no new vibrational or secular instabilities can occur. (2) Terms quadratic in w do not change either the shapes of the normal modes or the characteristic frequencies for radial pulsations. Thus, they have no influence on radial stability. (3) Terms quadratic in w do change both the normal modes and the characteristic frequencies of nonradial pulsations; but in the limit of a neutral mode these changes vanish. Hence, there is no modification of the criterion for convective stability, i.e., the standard Schwarzschild criterion remains valid. (auth)

13351 ANALYTIC NEUTRON-STAR MODELS. Adams, R.C.; Cohen, J.M. (Physics Department, University of Pennsylvania, Philadelphia, Pennsylvania 19104); Adler, R.J.; Sheffield, C. Phys. Rev. D 8: No. 6, 1651-1653 (15 Sept 1973).

We give a fully relativistic and analytic solution representing a slowly rotating neutron-star model. (auth)

13352 DEUTERIUM ABUNDANCE IN YOUNG STARS. Ostriker, J.P. (Department of Astronomy, University of California, Berkeley); Bodenheimer, P. Astrophys. J. Lett. 184: No. 1, L15-L18 (15 Aug 1973).

Deuterium ignites within protostars approaching the main sequence before significant hydrogen burning occurs. If the interstellar gas from which stars are formed has a sufficiently high abundance of deuterium, young clusters will contain low-mass stars still on the "deuterium main sequence," 3-4 mag above the hydrogen main sequence. The absence of such stars in the Pleiades cluster limits the deuterium abundance to $D/H < 1.5\times10^{-3}$ by number of atoms. Improved observations can lower this limit by more than a factor of 2. (auth)

13353 GROUND STATE OF ATOMS AND MOLECULES IN A SUPERSTRONG MAGNETIC FIELD. Constantinescu, D.H.; Rehák, P. (Scuola Normale Superiore, Pisa, Italy). Phys. Rev. D 8: No. 6, 1693-1706 (15 Sept 1973).

In superstrong magnetic fields, of the order of magnitude supposed to exist in neutron stars, atoms are characterized by enormous binding energies, small dimensions, and a very elongated distribution of charge having approximately the shape of a concave-ended cylinder. Their ionization energies have a monotonic dependence on the atomic number, and tend to level off at high Z; the very peculiar distribution of charge favors the formation of negative ions. When the magnetic field increases, nuclei tend to align and share their electrons, forming linear molecules. These features are very different from those of ordinary matter, and may have important astrophysical consequences, e.g., on the emission of charged particles from the surface of a magnetic neutron star, or the structure of its crust. (auth)

13354 WOLF-RAYET AND HIGH-TEMPERATURE STARS. Bappu, M. K. V.; Sahade, J. (eds.). International Astronomical Union Symposium No. 47. Lawrence, MA; D. Reidel Publishing Company, Inc. (1973). 275p. (CONF-710856-). $30.50.

Thirteen papers were presented and covered such topics as: extended atmospheres and nonclassical atmospheric models and their bearing on the W-R stars; low-dispersion spectroscopy and spectrophotometry; classification of W-R stars; galactic distribution; interpretation of the WN sequence; uv and r-f observations; effective temperatures; high-dispersion studies; properties of objects related to W-R stars; evolutionary aspects of W-R stars and their mass loss characteristics; theory of W-R spectra; W-R binaries and atmospheric stratification; WC stars; and problems of the nature and physical structure of W-R stars. (WDM)

13355 ACCRETION BY NEUTRON STARS AT THE GALACTIC CENTER. Maraschi, L. (Univ., Milan); Treves, A.; Tarenghi, M. Astron. Astrophys.; 25: No. 1, 153-155(May 1973).

The central region of the Galaxy is considered and the density of stars and interstellar matter is estimated. The power owed to accretion by neutron stars is calculated for an r.m.s. velocity of ~160 km/s as from the virial theorem. An upper limit for the accretion luminosity at x-ray wavelengths is proposed. The limit is nearly two orders of magnitude below the power of GCX. (auth)

13356 APSIDAL MOTION IN THE BINARY SYSTEM V 453 CYGNI. Wachmann, A. A. (Hamburg Observatory). Astron. Astrophys.; 25: No. 1, 157-158(May 1973).

About 2700 photographic and 2000 photoelectric observations in B and V of V 453 Cyg, covering 3000 epochs, show that there is a well established apsidal motion. The orbital eccentricity is 0.020 and the period of apsidal rotation 72 years. This fact removes the discrepancies between the photometric elements of Cohen and Pearce's spectroscopic elements as pointed out by Cohen. From the half-sums of the observed primary and secondary minima new mean light elements were derived. The new elements are: Min I = JD 2436508.3243 + 3^{d}.8898244 E and Min II = JD 2436510.2692 + 3^{d}.8898244 E. (auth)

13357 BLANKETING THEORY AND THE G-I INDEX. Perrin, M. N. (Observatoire de Lyon, Saint Genis-Laval, France). Astron. Astrophys.; 25: No. 1, 79-83(May 1973).

The blanketing theory of Wildey, Burbidge, Sandage, and Burbidge was tested by means of the G-I index (Lick system). It was found that blanketing theory slightly underestimates the T_{eff} of extreme sub-dwarfs. It is proposed that, for these stars, the blanketing corrections, $\Delta(B-V)$, be diminished by about 0.03. The corrections $\Delta(B-V)$ obtained through using the $(R-D)_\eta$ or $(R-D)_K$ indices (Johnson et al., 1968; Taylor, 1970; Eggen, 1971) are discussed. (auth)

13358 CENTRAL GRAVITATIONAL FIELD OF STARS AND EVOLUTION TO RED GIANTS. Hoeppner, W.; Weigert, A. (Hamburger Sternwarte, Hamburg). Astron. Astrophys.; 25: No. 1, 99-103(May 1973).

In order to determine the effect mainly responsible for the evolution into the red giant region after central hydrogen burning, models are considered in which the physical properties are altered artificially. In this way, the effects of a strong gravitational field and of inhomogeneities in the molecular weight and the energy generation rate are separated as far as possible. It is shown that only a strong central gravitational field yields models with properties similar to those of red giants. (auth)

13359 DETERMINATION OF VAN DER WAALS BROADENING OF FE I EMISSION LINES INDUCED BY NEUTRAL HE. Copley, G. H.; Camm, D. M. (Univ. of British Columbia, Vancouver). Astron. Astrophys.; 24: No. 2, 239-246(Apr 1973).

The Van der Waal's broadening coefficients for a number of Fe I emission lines in the wavelength range of 3600 to 5000 Å were measured at pressures of up to 200 Torr of He in a glow discharge. Accurate lineshape measurements on a small number of lines were carried out with a scanning Fabry-Perot interferometer using "lock-in" detection techniques while slightly less accurate line widths were obtained for a larger number of lines from photographic recording of the Fabry-Perot pattern. The measured coefficients were approximately 50% larger than those predicted by the formulae of Griem (1964). They were, however, in reasonable agreement with the line-broadening calculations of Fullerton and Cowley (1971) who considered the effect of higher order terms in the interaction potential between two neutral atoms. (auth)

13360 EQUIVALENT WIDTHS OF MG II LINES NEAR 2800 Å IN THE SPECTRA OF 31 STARS. Lamers, H. J. (Astronomical Inst., Utrecht); van der Hucht, K. A.; Snijders, M. A. J.; Sakhibullin, N. Astron. Astrophys.; 25: No. 1, 105-112(May 1973).

The total equivalent width of the Mg II lines λ 2795.5, λ 2802.7 ($3s^2S-3p^2P^o$); and λ 2790.8, λ 2798.0 ($3p^2P^o-3d^2D$) was measured in the spectrograms of 31 stars, observed by the Orbiting Stellar Spectrophotometer S 59. After corrections for the interstellar components were applied, the equivalent widths in various types of stars were compared with each other. The B-type supergiants O^2 CMa and η CMa showed stronger Mg lines than normal stars, whereas the peculiar star α^2 CVn had weak lines. Two Be-stars showed weak lines and two Be stars showed normal line strength. In middle and late-B type stars of class II-V the observed equivalent widths agreed with non-LTE predictions, but in early-B stars the observed lines were too strong. Several possible explanations for the origin of this discrepancy are discussed. (auth)

13361 EVOLUTION MODELS OF SPHERICAL SYSTEMS OF STARS AND GALAXIES. Petrovskaya, I. V. (Leningrad State

Univ.). Postepy Astron.; 21: No. 3, 233-250(Sep 1973). (In Polish).

The spherical systems of stars and galaxies are supposed to be formed as a result of condensation of bodies in a diffuse spherical cloud or as a result of the eruption of some superdense body. Then during the first stage of the evolution the orbits of the system members are nearly rectilinear. In the course of evolution the transversal velocity components increase and the system approaches the state that is quasistationary on the whole. Some spherical models emerge with a radially elongated velocity distribution. These models closely represent density distribution observed in the Coma Cluster of galaxies and in the outer regions of globular clusters. Relative dimensions of the central regions are used for the estimation of the age of globular clusters. To estimate the age of globular clusters relative dimensions of the central regions are used. (auth)

13362 EVOLUTION OF MASSIVE POPULATION II STARS. Trimble, V. (Univ. of California, Irvine); Paczynski, B.; Zimmerman, B. A. Astron. Astrophys.; 25: No. 1, 35-40(May 1973).

Evolutionary tracks are presented for 2, 3, 10, 12, and 30 $M_\odot$ stars having X = 0.7 and Z = 0.001. Both the main sequence and the Hayashi limit are bluer than for metal-rich stars, and the main-sequence models have higher luminosities, central temperatures and densities, and smaller radii. The higher luminosity shortens the time scales of the evolution for a given mass. Helium burning occurs close to the main sequence for the 10, 12, and 30 $M_\odot$ models, rather than in the red giant phase. These differences can be understood qualitatively. The main sequence convective cores, and thus the helium cores formed, are larger than for corresponding higher Z models. Metal-poor stars are therefore capable of contributing a larger amount of helium to the galaxy than metal-rich stars. (auth)

13363 EXPANSION OF V1016 CYGNI. Fitzgerald, M. P. (Univ. of Waterloo, Ont.). Nature (London) Phys. Sci.; 245: No. 143, 58-59(24 Sep 1973).

It has been found that the peculiar emission object V 1016 Cygni shows radio emission, and also a marked infrared excess. In view of the interest these results have caused, some spectroscopic studies, made in 1973, with particular regard to the interpretation of line widths reported previously, are presented. Observations on IIaOB emission were taken on a 12 Å/mm plate at the David Dunlap Observatory. Inspection of the line appearance clearly indicated that there was an absorption-like core between the red and violet side of the observed emission line. The line structure is interpreted as arising from three spectral components; an expanding nebula moving away from the central star produces the two strong components on either side of the absorption-like core, and a third violet shifted component is produced by material spewing from the star surface. Experiments were made to test this hypothesis. It is suggested that the two major components are due to an asymmetric expanding nebula, moving away from the central star at about 34 km/sec. In order to maintain the high electron densities of 10^6 to 10^7 cm^{-3} the nebula must receive a net inflow of matter; this is provided by the central star spewing off material at about 105 km/sec. This material is then captured by the more slowly expanding nebula. (UK)

13364 EXPLODING MASSIVE OBJECTS. Appenzeller, I.; Tscharnuter, W. (Univ., Goettingen, Ger.). Astron. Astrophys.; 25: No. 1, 125-128(May 1973).

Hydrodynamic model calculations of the evolution of nonrotating massive objects with Population I chemical composition for different mass values were carried out. The numerical results indicate that all such objects in the mass interval $4.1 \leq 10^{-5}\ M/M_\odot \leq 7$ terminate their evolution by violent thermonuclear explosions in which energies between 3×10^{56} erg and 1×10^{57} erg are liberated. The relative amount of helium that is produced during the explosions was found to reach its maximum value at about $M = 5.2 \times 10^5\ M_\odot$. (auth)

13365 HD 105563 IS A STAR OF VV CEPHEI TYPE. Lynga, G. (Lund Observatory, Sweden). Astron. Astrophys.; 24: No. 2, 303-304(Apr 1973).

From its spectrum HD 105563 is classified as a star of VV Cephei type. The star is a member of a small group of early type stars so that an absolute magnitude can be derived. Photometric observations show slight indications of variability. (auth)

13366 HEINZE 177: SLOW NOVA, SYMBIOTIC STAR, X-RAY SOURCE. Webster, B. L. (Royal Greenwich Observatory, Hailsham, Eng.). Mon. Notic. Roy. Astron. Soc.; 164: No. 4, 381-394(1973).

The rich emission-line spectrum of Henize 177 between 3300 Å and 7100 Å is described. Changes in line intensities occur between 1965 and 1972, but no short term radial velocity variation can be established. There is a line width, ionization level relation and the object must contain separate regions of varying velocity, ionization, and physical conditions. The mode of ionization and excitation, collisional or radiative, and possible models of the system, single or binary, are discussed. Irrespective of whether the suggested identification of H 177 with the x-ray source of 2U 1639-62 is correct, the star contains high-velocity gas with enough energy to produce x rays. (auth)

13367 INFRA-RED OBSERVATIONS OF YOUNG STARS. IV. Radiative Mechanisms and Interpretations. Cohen, M. (Univ. of California, Berkeley). Mon. Notic. Roy. Astron. Soc.; 164: No. 4, 395-421(1973).

Recently published multifilter infrared observations of various categories of young stars are discussed. These data are used to suggest a possible mechanism for the infrared emission, to derive bolometric magnitudes for young stars, and, by assuming that all these stars are on their radiative tracks in the HR diagram, to present a model of early stellar evolution. In this model the infall of material from a circumstellar shell surrounding the protostar, and mass loss from the central core, are the principal processes in terms of which the observations are interpreted. (auth)

13368 IS DELTA CEP SUPER IRON RICH? van Paradijs, J.; de Ruiter, H. (Astronomical Inst., Amsterdam). Astron. Astrophys.; 24: No. 2, 317-319(Apr 1973).

A re-analysis of the equivalent width data from four spectrograms of δ Cep, using model atmospheres, shows that the conclusion of Kobayashi and Takeuti (1971), namely that δ Cep is "super iron rich", is highly improbable. The large differences in abundances, amounting to 0.70 dex, can be explained from errors in the determination of the equivalent widths and in the ionization temperatures. (auth)

13369 JASCHEK AND BRANDI'S LINE IDENTIFICATIONS FOR HD 25354. Adelman, S. J. (Goddard Space Flight Center, Greenbelt, MD). Astron. Astrophys.; 24: No. 2, 325-328(Apr 1973).

Jaschek and Brandi's suggested line identifications for HD 25354 are examined and found to be highly suspect. (auth)

13370 LINE PROFILES AND ROTATION IN WHITE DWARFS. Greenstein, J. L. (Hale Observatories, Pasadena, CA); Peterson, D. M. Astron. Astrophys.; 25: No. 1, 29-34(May 1973).

Two hydrogen-line white dwarfs, 40 Eri B and Wolf 1346, show sharp cores in H_α and H_β on Palomar image-tube coudé spectra. The cores are slightly wider than the instrumental profile. Sharp cores are predicted from model atmospheres in which departures from LTE are allowed. The cores are formed at sufficiently small optical depths that collisions are only comparable to photoionizations in destroying H_α photons. Theoretical profiles were computed for various rotational velocities. Convoluted with the instrumental profile, they were compared with the observations. It was found that 40 Eri B appears to have a finite rotational velocity, v sin i = 40 (+20, −10) km s^{-1}. For W 1346 projected velocity of v sin i = 50 (+30, −20) km s^{-1} also, probably significantly, differs from zero. These two white dwarfs are therefore slow rotators and have been able to dispose of most of their angular momentum before reaching their final state. (auth)

13371 NATURE OF THE LIGHT VARIATION OF THE PECULIAR A-STAR HD 221568. Kodaira, K. (Univ., Heidelberg). Astron. Astrophys.; 25: No. 1, 93-97(May 1973).

The light variation of the extraordinary Ap-star HD 221568 is interpreted as the result of the varying line blanketing. The line blocking factors are measured for λλ 4100 to 5900 Å, amounting up to 43% for the scanner pass-band of λ 4167 Å at the "red" phase. The Paschen continua observed by Kodaira (1969), corrected for the line blocking, can be well represented by the theoretical continua by Mihalas (1966), when an interstellar reddening correction of $\delta m_v = 0.30/\lambda(\mu) + \text{const}$ is applied. The apparent effective temperature of the Paschen continuum is $\theta_e = 0.45$ at the "blue" phase and $\theta_e = 0.40$ at the "red" phase. It is shown that this increase in temperature of the inner atmospheric layers at the "red" phase can be caused by line blocking of the order of 30 to 50% in the far-ultraviolet region λλ 912 to 3000 Å. (auth)

13372 NUMERICAL EXPERIMENTS ON THE STABILITY OF SPHERICAL STELLAR SYSTEMS. Henon, M. (Observatoire de Nice). Astron. Astrophys.; 24: No. 2, 229-238(Apr 1973).

The concentric shell model is used to investigate numerically the stability of spherical steady-state stellar systems with respect to spherical disturbances. Polytropic models with an isotropic velocity distribution are found to be stable almost down to the limiting index value n = ½. "Generalized polytropes", with a distribution function depending on energy and angular momentum, show instability when n is low and the velocity distribution is radially elongated. (auth)

13373 OPTICAL STUDY OF BL LACERTAE. II. Brightness Variation from March 1969 to January 1971. Bertaud, C. (Ob-

servatoire de Paris, Meudon, France); Wlerick, G.; Veron, P.; Dumortier, B.; Bigay, J.; Paturel, G.; Duruy, M.; de Saevsky, P. Astron. Astrophys.; 24: No. 3, 357-368(May 1973). (In French).

BL Lacertae has been monitored in the visible during the years 1969 and 1970. The result of Racine was confirmed: there is a correlation between the color index B−V and the V magnitude; as a result, the slope of the spectrum in the log v, log F(v) diagram increases when the optical flux decreases. The light curve was constructed with 370 visual measurements and the values obtained from 355 photographic plates. The curve shows large oscillations that may last for several months and, in addition, periods of high activity, characterized by maxima and minima of short duration (from one hour to one day) that may correspond to the presence of one (or a few) small active region(s). The statistical analysis of all the measurements made during the period June 1968−January 1971 does not show any marked difference from the few measures known for the period 1900−1968. The changes are rather quick and during the 3-year period the interval of variation ($13.7 < B < 16.5$) has been covered many times. The histogram of the optical flux is asymmetric and this may be related to the fact that the main active events are rare and of short duration. Harmonic analysis does not show the presence of a periodic term in the light curve and a correlation between the optical flux and the radio flux in the centimeter region was not found. (auth)

13374 PLANETARY NEBULAE: TWO TYPES. Smith, H. (Univ. of South Florida, Tampa). Mon. Notic. Roy. Astron. Soc.; 164: No. 4, 321-327(1973).

It is proposed that there are two distinct types of planetary nebulae, distinguishable observationally on the basis of Doppler expansion velocity and the difference in brightness of the nebula and its central star. The distinction extends also to the spectral types of the central stars and is related to differences found by Kaler (Astrophys. J.; 160: 887(1970)) between planetaries with differing chemical composition. (auth)

13375 PRELIMINARY RESULTS OF THE STUDY OF β-LYRAE DURING THE INTERNATIONAL CAMPAIGN OF JULY−AUGUST 1971. Hack, M. (Astronomical Observatory, Trieste, Italy). Astron. Astrophys.; 24: No. 2, 329-333(Apr 1973).

From a study of spectrograms of β Lyrae in the spectral range $\lambda\lambda$ 4800 to 6700 taken during the period July 18−August 1, 1971 it appears that the radial velocities given by the absorption cores of Hα, Hβ, and of the nonmetastable lines of He I, λ 6678 and λ 5875 vary out of phase with the orbital velocity curve showing a minimum of about -120 km s^{-1} at phase 0d and a broad maximum of about -50 km s^{-1} at phases included between 5d and 10d. The metastable line of He I λ 5015 and the two shell components of the Na I D lines have an almost constant velocity of -120 km s^{-1}. The radial velocity of the center of the emission lines Hα, λ 6678 and λ 5875 is roughly constant and equal to the velocity of the center of mass of the system. The epochs of the appearance of the red and violet satellite lines of Si II confirm the photoelectric data for the epoch of the minimum which occurs about 0.13d before the predicted epoch. The absorption line intensity is minimum and the emission intensity is maximum at light minima. (auth)

13376 PULSATIONAL INSTABILITY OF A STAR OF 0.5M$_\odot$ DURING CORE HYDROGEN BURNING. Boury, A.; Noels, A. (Univ., Liege). Astron. Astrophys.; 24: No. 2, 255-258(Apr 1973).

The stability of a 0.5 M$_\odot$ star towards radial oscillations was investigated. The evolutionary stages starting at the ignition of hydrogen at the center up to its near exhaustion in the core were covered. All models were found unstable, not only because of nuclear reactions but also because of the effects of convection. In consequence, the use of the available theory of convection is open to question. (auth)

13377 RADIAL VELOCITY VARIATIONS OF HD 125823 α CENTAURI. Underhill, A. B.; Klinglesmith, D. A.; Frey, H. (Goddard Space Flight Center, Greenbelt, MD). Astron. Astrophys.; 25: No. 1, 141-144(May 1973).

Radial velocities are presented from 66 spectrograms of HD 125823 α Centauri obtained on ten consecutive nights. The lines of He I when plotted against the phase of the He I line strength variation tend to be positively displaced with respect to the mean velocity at phases near 0.3 and negatively displaced around phase 0.7 to 0.8. The lines of N II show a clear reversal of this behavior. The lines of H, C II, Mg II, and Ca II show no particular trend while the lines of Si II and Si III show a slight tendency to vary like the N II lines. (auth)

13378 SECULAR STABILITY. IV. The Effect of Shell Sources on the Secular Spectrum. Aizenman, M. L. (Univ. of Montreal); Perdang, J. Astron. Astrophys.; 25: No. 1, 53-57(May 1973).

The method of successive approximations used to discuss the onset of complex roots in the secular spectrum is extended to the case where shell sources are present in the star. Parameters describing the intensity and position of such sources are defined, and their influence on the secular spectrum is discussed. Secular eigenvalues are determined for different choices of these parameters. (auth)

13379 SECULAR STABILITY OF AN 8M$_\odot$ STAR DURING CENTRAL HELIUM BURNING. Noels, A.; Gabriel, M. (Univ., Liege). Astron. Astrophys.; 24: No. 2, 201-208(Apr 1973).

The secular stability of an 8 M$_\odot$ population I star during the phase of central He burning was studied. As soon as nuclear reactions set in the core and up to the end of this phase, the secular eigenspectrum possesses at least two complex conjugate roots associated with the first two modes. An instability appears soon after the onset of the He burning. The stability is however rapidly restored and is maintained throughout the remainder of the phase. The reason of the instability is discussed. (auth)

13380 SPOTTED FLARE STARS BY DRA AND CC ERI: A MODEL FOR THE SPOTS AND SOME ASTROPHYSICAL IMPLICATIONS. Bopp, B. W.; Evans, D. S. (Univ. of Texas, Austin). Mon. Notic. Roy. Astron. Soc.; 164: No. 4, 343-356(1973).

The photometric behavior of the flare stars BY Dra and CC Eri outside flare activity is discussed. Excellent agreement with the photometric light curves is possible if they are interpreted as due to the rotation of a star having a cool, dark spot on its surface. The orbital solution of the BY Dra system is presented. The system has a very high eccentricity and is presumably young. The inclination of the orbital plane places strong restrictions on the location of the spots. A model for the spotted areas is developed, incorporating four free parameters: longitude extent, latitude extent, limb darkening, and temperature. It is shown that the spots must be large, covering up to 20 per cent of the stellar hemisphere and with effective temperatures near 2000°K. In addition, the spots must extend to high latitudes (up to 60°). The model effectively explains the general lack of (B-V) variations over the photometric cycle: the spot is black at these wavelengths relative to the stellar photosphere. Estimates of the magnetic field necessary for the storage of part or all of the energy dammed back by the spots are in the range of a few thousand gauss. An energy balance argument suggests that the essence of the flare phenomenon is the release through magnetic field collapse of energy temporarily stored in the field. (auth)

13381 STARK BROADENING AND SHIFT OF SINGLY IONIZED ALUMINIUM LINES. Heuschkel, J.; Kusch, H. J. (Univ., Kiel). Astron. Astrophys.; 25: No. 1, 149-151(May 1973).

Line profiles of four Al II-lines were measured observing the side-on emission of the plasma flame protruding from a pulsed discharge through aluminium hydride capillaries. The electron density varied in the range 0.5 to $3 \cdot 10^{17}$ cm^{-3}, the plasma temperature was approximately 20000°K. The half widths of the lorentzian shaped lines differed markedly from theoretical values obtained by Griem's semi-empirical approximation. (auth)

13382 ULTRAVIOLET LINE BLANKETING IN EARLY TYPE ATMOSPHERES. Eberlein, D.; Scholz, M.; Traving, G. (Univ., Heidelberg). Astron. Astrophys.; 24: No. 2, 295-298(Apr 1973).

Ultraviolet line blanketing in early type atmospheres is discussed. Taking into account realistic damping constants and approximative non-LTE effects, heating of the atmosphere turns out to be smaller than found in the Princeton computations. (auth)

13383 POSSIBLE THERMAL INSTABILITY OF HYDROGEN BURNING SHELLS. Bolton, A. J. C.; Eggleton, P. P. (Inst. of Astronomy, Cambridge, Eng.). Astron. Astrophys.; 24: No. 3, 429-434(May 1973).

A simplified model of a nuclear burning shell is investigated for its stability to radial perturbations on a thermal (Kelvin-Helmholtz) timescale. It is found that instability, with either complex or real growth rate, can occur if the energy generation rate increases with temperature sufficiently steeply. Helium shells should be unstable according to this analysis; but the analysis also suggests that hydrogen burning shells may be unstable, by a narrow margin. (auth)

13384 INITIAL ASYMPTOTIC BRANCH EVOLUTION OF POPULATION II STARS. Sweigart, A. V. (Yale Univ., New Haven). Astron. Astrophys.; 24: No. 3, 459-464(May 1973).

The asymptotic branch evolution for Population II stars of 0.6 and 0.8 M$_\odot$ was followed from helium exhaustion in the core through the initial relaxation cycles with a detailed treatment of the envelope physics. The 0.6 M$_\odot$ star never deviated from the asymptotic branch by more than 0.01 in log T_{eff} in response to the helium-shell flashes during the first two active phases. This star thus did not enter the instability strip for Population II Cepheids although it would be expected to do so from the results of Schwarzschild and Härm (1970). The 0.8 M$_\odot$ star also

did not move off the asymptotic branch during the first relaxation cycle. In an appendix are given both fitting formulas for the conductive opacity and a procedure for solving the Saha ionization equations. (auth)

13385 INTERACTION BETWEEN CORE AND ENVELOPE IN STARS WITH CENTRAL HELIUM BURNING. Lauterborn, D. (Univ. of Colorado, Boulder). Astron. Astrophys.; 24: No. 3, 421-427(May 1973).

The interaction between core and envelope in stars with central helium burning is investigated. If core and envelope are treated as independent systems, feedback terms arise. All feedback terms are discussed in detail. The approximative treatment of feedback terms in the earlier papers of Lauterborn, Refsdal, and Weigert is found to be fully justified. The problem of secular instabilities in models with central helium burning is rediscussed. (auth)

13386 EVOLUTION OF A CONTACT BINARY. Hazlehurst, J. (Univ. of Sussex, Eng.); Meyer-Hofmeister, E. Astron. Astrophys.; 24: No. 3, 379-392(May 1973).

The evolution of a contact binary with a primary of 1.5 $M_\odot$ and a secondary of 1.1 $M_\odot$ was studied. It was assumed that no appreciable difference would develop between the entropies of the adiabatic portions of the convection zones of the two stars, and reasons are given for this assumption. It was found that mass flows from the primary to the secondary component and it was estimated that the system would reach equal mass after about 10^8 yr. The relative frequency and other properties of the W UMa systems are discussed in the light of these results. (auth)

13387 APPLICATION OF AUTOMATION TO THE MEASUREMENT AND REDUCTION OF HIGH DISPERSION STELLAR SPECTRA. Patchett, B. E.; McCall, A.; Stickland, D. J. (Royal Greenwich Observatory, Hailsham, Eng.). Mon. Notic. Roy. Astron. Soc.; 164: No. 4, 329-341(1973).

The case for use of automated abundance analysis procedures is examined and the progress made in that direction is reviewed. A program for the automatic measurement of equivalent widths is now operational and giving successful results for sharp lined A stars. Results for the Am star 88 Tauri, which exhibits significant rotational broadening, differ from previously published data and suggest that the older high dispersion measures suffer more from the effects of a rotationally depressed apparent continuum. Abundances are derived for 88 Tauri through computer analysis based on the differential curve of growth. (auth)

13388 USE OF UBV PHOTOMETRIC DIAGRAMS FOR INFERRING THE EXISTENCE OF AN OPEN STAR CLUSTER. Burki, G.; Maeder, A. (Observatoire, Geneva). Astron. Astrophys.; 25: No. 1, 71-77(May 1973).

In order to discuss the arguments which may be drawn from UBV photometric data on the existence or nonexistence of an open star cluster, simulations were made of UBV measurements for field stars under very classical assumptions on interstellar reddening, luminosity function, distribution of stars in space, and spread on the main sequence. The simulations clearly showed that field stars may give well-behaved "sequences" in the UBV diagrams. The reasons why field stars give such features are shown. From this, it is assumed that the presence of sequences in photometric diagrams must not be taken, as is frequently the case, as proof of the real existence of a cluster. Some characteristics are defined, allowing to discriminate "sequences" of field stars from those of real clusters. (auth)

13389 X-RAY AND RADIO EMISSION FROM STELLAR CORONAE. Landini, M.; Monsignori Fossi, B. C. (Arcetri Astrophysical Observatory, Florence). Astron. Astrophys.; 25: No. 1, 9-16(May 1973).

Recent models of solar type coronae were analyzed in order to give expected x-ray and radio waves fluxes. Hard x-ray (1-8 Å), soft x-ray (44-60 Å), and metric fluxes were computed for a selected number of stars. Soft x-ray emission from stellar coronae within 200 pc may account for a large fraction of the soft x-ray background. (auth)

13390 DIFFERENTIAL ROTATION, MAGNETIC FIELDS, AND THE SOLAR NEUTRINO FLUX. Bartenwerfer, D. (Univ., Goettingen, Ger.). Astron. Astrophys.; 25: No. 3, 455-456(Jun 1973).

Attempts to explain the missing flux of solar neutrinos as internal rotation (Ulrich, 1969) or as magnetic fields hidden in the interior of the Sun (Bahcall and Ulrich, 1971) have been, to date, unsuccessful. In both cases the authors found only small changes in the solar neutrino flux—in the case of magnetic fields the change was in the wrong direction. It is shown that differential rotation and magnetic fields yield smaller solar neutrino fluxes than previously calculated if one chooses appropriate angular velocity distributions or appropriate magnetic fields. (auth)

13391 STATISTICS OF β LYR AND W UMa TYPE ECLIPSING BINARIES. Linnaluoto, S.; Vilhu, O. (Univ. of Helsinki). Astron. Astrophys.; 25: No. 3, 481-484(Jun 1973).

Statistics relating to EB (β Lyr) and EW (W UMa) type eclipsing binaries were prepared with the purpose of investigating the uniformity of these groups. A gap in the distribution of the differences between the surface brightnesses of the components exists. This points to the detachment of EB- and EW-groups, or to the discontinuous character of the physical process equalizing the surface temperatures in components of EW type systems. The parameter F might give a quantitative classification criterion to separate the EB and EW groups. (auth)

13392 STATISTICS OF THE β CEPHEI STARS. Lesh, J. R. (Univ. of Colorado, Denver); Aizenman, M. L. Astron. Astrophys.; 26: No. 1, 1-9(Jul 1973).

A statistical study of the β Cephei variables drawn from a homogeneous and complete sample of early B stars leads to the following conclusions: 1) The percentage of confirmed β Cephei variables among the early B stars is comparable to the fraction of the evolutionary lifetime spent in the secondary contraction and early shell-burning phases. 2) The percentage of binaries among β Cephei variables is about the same as that for nonvariable, B-type giants. 3) The classical β Cephei variables tend to occur at high galactic latitudes because they are members of the inclined system of the Gould Belt. 4) The β Cephei variables occur in associations about as frequently as B stars in general. Those that are members of well-studied associations have positions in the H-R diagram compatible with the evolutionary ages of the associations. (auth)

13393 OBSERVATIONS OF DIFFUSE INTERSTELLAR FEATURES IN THE SPECTRA OF DUST-EMBEDDED AND FIELD STARS. Bromage, G. E.; Nandy, K. (Royal Observatory, Edinburgh). Astron. Astrophys.; 26: No. 1, 17-32(Jul 1973).

Observations are presented of twelve interstellar features of the spectra of dust-embedded and field stars in comparable direction in the galactic plane, the wavelength range being 550 to 700 nm. The spectra were obtained at a dispersion of 6 nm mm^{-1} with the Cassegrain spectrograph of the 98" Isaac Newton telescope of the Royal Greenwich Observatory. Equivalent widths, central depths, half widths, and central wavelengths of these features were studied. It was found that their relative strengths, widths, and positions were the same for dust-embedded as for field stars. The lack of correlation between the strengths of sodium D lines and diffuse lines for the stars in and near the association Cyg OB 2 (VI Cyg) was very striking. It has been suggested that the heavily reddened members of Cyg OB 2 (VI Cyg) have no circumstellar shells but are located in the densest regions of the parent dust cloud. The observations endorsed this view. (auth)

13394 BEHAVIOR OF THE HYDROGEN LINES IN THE β CEPHEI STAR ν ERIDANI. Laskarides, P. G. (Univ. of Athens). Astron. Astrophys.; 26: No. 1, 91-93(Jul 1973).

Noncentral "filling in" of the absorption hydrogen lines by emission from the extended atmosphere may cause the difference in the behavior of the hydrogen line profiles, compared to the Si III line profiles, as well as the apparent correlation between the phase of the sharper line profile and the wavelength of the line, reported earlier. (auth)

13395 ATMOSPHERE OF THE HYDROGEN-DEFICIENT STAR HD 96446. Wolf, R. E. A. (Technische Univ., Berlin). Astron. Astrophys.; 26: No. 1, 127-136(Jul 1973).

A quantitative fine analysis of the hydrogen-deficient star HD 96446 was performed by using a grid of flux-constant model atmospheres. 6 Coudé-spectrograms (dispersion 12.3 Å/mm) were taken with the ESO 152 cm telescope at La Silla. Opacity sources considered were H I, H^-, He I, He II, He^-, electron scattering, and Lyman- and Balmer-lines. The following quantities were computed: the profiles of H_γ and H_δ, the equivalent widths and profiles of five He I-lines, the ionization equilibria of He I/He II and Si II/Si III, and the turbulent velocity. The model that fit the observations best had T_{eff} = 25250°K, log g = 4.20, n_H = 0.508 (number fraction of hydrogen), and ν_t = 5 km/s. The abundance analysis yielded the fact that oxygen was under-abundant by a factor of 13 with respect to normal B-stars. The other metal abundances were approximately normal. Mass, radius, and luminosity were determined to be $M/M_\odot$= 7.6, $R/R_\odot$= 3.6, log $L/L_\odot$= 3.70. This result is typical for the intermediate subclass of hydrogen-deficient stars. (auth)

13396 VARIABLE STARS AMONG Ca II EMISSION BINARIES. Herbst, W. (Univ. of Toronto). Astron. Astrophys.; 26: No. 1, 137-140(Jul 1973).

Two new strong Ca II emission binaries (HD 213389 and HR 8703) are reported and both are shown to be light variables. HR 7275 is suspected of variability. Data on seven strong Ca II emission

binaries, all of which show evidence of light variation, are discussed. Four of these also have peculiar spectra in that their special types determined from hydrogen line criteria are earlier than those determined from metallic line ratios. (auth)

13397 Mg II LINES AT 2800 A IN THE SPECTRUM OF α^2 CANUM VENATICORUM. Burger, M. (Astrophysical Inst., Brussels); van der Hucht, K. A.; Lamers, H. J. Astron. Astrophys.; 26: No. 1, 149-153(Jul 1973).

Ultraviolet spectra of α^2 CVn were obtained by the Utrecht Orbiting Stellar Spectrophotometer S 59. The observations were compared with LTE-model calculations. Upper limits of the combined Mg-abundance and microturbulent velocity were obtained. If a microturbulent velocity of 1.5 km/s is assumed, the Mg-abundance is smaller than 7.2. (auth)

13398 LIFETIME MEASUREMENTS OF OPTICAL LEVELS FOR 6 ELEMENTS OF ASTROPHYSICAL INTEREST. Marek, J.; Richter, J. (Univ., Kiel). Astron. Astrophys.; 26: No. 1, 155-157(Jul 1973).

The mean lifetimes of 25 optical levels of Mg I, Al I, Si I, Cr I, Co I, and Mn I were determined with the phase-shift method. The measured values can be used to calibrate previously determined scales of relative oscillator strengths. (auth)

13399 LIGHT CURVE AND PROPERTIES OF TYPE I SUPERNOVAE. Barbon, R.; Ciatti, F.; Rosino, L. (Asiago Astrophysical Observatory, Padua). Astron. Astrophys.; 25: No. 2, 241-248(Jun 1973).

By the best fitting of all available light curves of Type I supernovae an average curve, representative of the class, was drawn. Due to the strong similarity of the light curves, the dispersion of the points was relatively small. From the analysis of the average curve some general properties of the SN-I were derived. The occurrence of Type I supernovae in different types of galaxies and the possibility of a further subdivision in two groups are discussed. (auth)

13400 STUDY OF B 6 STARS. Underhill, A. B. (Goddard Space Flight Center, Greenbelt, MD). Astron. Astrophys.; 25: No. 2, 161-174(Jun 1973).

A study of the spectra of ζ Draconis, B 6 III, β Sextantis, B 6 V, and α Leonis, B 7 V, was made from high-dispersion spectrograms which cover the spectral region 3100 to 6700 Å and from OAO-II spectral scans covering the spectral region 1100 to 3600 Å. Profiles, equivalent widths, and central intensities of many lines in the spectrum of ζ Draconis and of the major lines of β Sextantis are presented. The star α Leonis rotates too rapidly for these measurements to be made from high-resolution spectrograms. (WDM)

13401 ULTRAVIOLET FLUX ENVELOPES OF MAIN-SEQUENCE B STARS. Underhill, A. B. (Goddard Space Flight Center, Greenbelt, MD). Astron. Astrophys.; 25: No. 2, 175-185(Jun 1973).

Flux envelopes on an absolute energy scale from 1100 to 6000 Å prepared from OAO-II scans and from published ground-based material are presented for λ Leporis, B 0.5 V, η Ursae Majoris, B 3 V, γ Ursae Majoris, A 0 V, and α Canis Majoris A 1 V from rocket scans. These, with flux envelopes for ζ Draconis, B 6 III, and α Leonis, B 7 V (Underhill, 1972) are intercompared and compared with reference flux envelopes predicated by LTE theory from lightly line-blanketed model atmospheres. A considerable line blocking occurs at wavelengths shortward of 3000 Å with respect to the theoretical continuous spectra. The line blocking may be as much as 50% at 1500 Å and between 1500 Å and 2500 Å it is comparable to that which exists in the Sun between 3000 Å and 4000 Å. Although γ Ursae Majoris, α Lyrae, and α Canis Majoris have very similar visible spectra when viewed at low resolution, their ultraviolet spectra are significantly different, in particular α Lyrae shows an ultraviolet excess. (auth)

13402 W URSAE MAJORIS STARS: A MODEL FOR THE W-SYSTEMS. Mochnacki, S. W.; Whelan, J. A. J. (Univ. of British Columbia, Vancouver). Astron. Astrophys.; 25: No. 2, 249-252(Jun 1973).

A model for the W-type W Ursae Majoris systems is presented in which the energy exchange occurs largely through the superadiabatic part of the common convective envelope and the secondary component is a few hundred degrees hotter than the primary. It is confirmed, by light curve synthesis, that such a model has the observed light curves. The model accounts for the W-type systems being of later spectral type and in shallow contact. It is predicted that A-type systems will tend to have small mass-ratios. (auth)

13403 SPECTRALPHOTOMETRY AND QUANTITATIVE ANALYSIS OF THE HYDROGEN-DEFICIENT STARS HD 144941 AND CPD-69°2698. Hunger, K.; Kaufmann, J. P. (Technische Universitaet, Berlin). Astron. Astrophys.; 25: No. 2, 261-270 (Jun 1973).

Wavelengths and equivalent widths are given for absorption lines in the spectra of the hydrogen-deficient stars HD 144941 and CPD-69°2698. The coudé-spectrograms were taken with the ESO 152 cm telescope at La Silla. The dispersion was 20 Å/mm (HD 144941) and 12.4 Å/mm (CPD-69°2698). Fine analyses were performed by using a grid of flux constant hydrogen-line blanketed models with varying T_{eff}, log g and ϵ_H (number fraction of H). The abundance analysis yielded the surprising result that in HD 144941, C and N is underabundant by a factor >10 with respect to normal B-stars (and drastically underabundant with respect to the helium–carbon star BD + 10°2179). In CPD-69°2698, the metal abundances are approximately normal, except for S which is underabundant by a factor of 10. The mass of HD 144941 is small ($m = 2.0\ M_\odot$) and the radius comparatively large ($R = 4.2 R_\odot$) which is typical for the extreme subclass of hydrogen-deficient stars. For CPD-69°2698 $m = 4.5\ M_\odot$ and $R = 3.1\ R_\odot$ result, which are both too small for the luminosity ($\log L/L_\odot = 3.8$). (auth)

13404 PLACES OF FORMATION OF NEARBY CLASSICAL CEPHEIDS. Wielen, R. (Observatoire, Nice). Astron. Astrophys.; 25: No. 2, 285-297(Jun 1973).

The places of formation of 19 nearby classical Cepheids are considered. The ages of the Cepheids are derived from the theoretical period–age relation which is checked by cluster Cepheids. The resulting ages of Cepheids range from 10^7 up to 10^8 years, with a maximum frequency near $5 \cdot 10^7$ years. The galactic orbits of the Cepheids are numerically integrated backwards in time using the present space velocities and positions derived and discussed elsewhere. The spiral field of the density wave proposed by Lin et al. is included in the galactic gravitational field used. The derived birthplaces of most nearby Cepheids are in agreement with the predictions of Lin's theory. Most of the nearby Cepheids probably orginated in the Sagittarius arm and in the Perseus arm. Only the youngest nearby Cepheids are not formed within these main spiral arms but are born probably in the local arm. While Lin's theory of density waves describes successfully the places of formation of most nearby Cepheids, other interpretations of the distribution of these birthplaces cannot be ruled out. (auth)

13405 SECULAR STABILITY OF STATIC MODELS DURING CENTRAL HELIUM BURNING. Gabriel, M.; Noels, A. (Univ., Liege). Astron. Astrophys.; 25: No. 2, 313-317(Jun 1973).

A sequence of static helium burning models was computed. The slope of the hydrogen profile, dX/dm, above the hydrogen burning shell was chosen as the free parameter. Sequences of envelope models were also computed. Their most typical feature was the S shape of the curve (p,r) at the bottom of the burning shell. All models were secularly stable. This result was interpreted according to the argument presented by Lauterborn et al. (1971), slightly modified. The relation between secular stability and linear series concept is discussed. (auth)

13406 HR 7955 AS A SPECTROSCOPIC BINARY. Spite, F.; Spite, M. (European Southern Observatory, Santiago de Chile). Astron. Astrophys.; 25: No. 2, 325-326(Jun 1973).

The star HR 7955 was suspected to be metal-rich. However, high-resolution spectra show double lines. The metal-abundance anomaly, derived without taking into account the binary nature of this star, has to be reconsidered. (auth)

13407 CHEMICAL ABUNDANCES IN THE WEAK-HELIUM-LINE STAR α SCULPTORIS. Baschek, B. (Univ., Heidelberg). Astron. Astrophys.; 25: No. 2, 333-335(Jun 1973).

A brief discussion and comparison of the recent abundance determinations in α Scl by Schmitt (1972) and Vilhu (1972) is given. (auth)

13408 ANOMALOUS FE I LINES IN HD 125823 α CENTAURI. Underhill, A. B.; Klinglesmith, D. A. (Goddard Space Flight Center, Greenbelt, MD). Astron. Astrophys.; 25: No. 3, 405-407 (Jun 1973).

Evidence is presented for the appearance of broad, shallow lines of Fe I in the spectrum of HD 125823 α Centauri between phases 0.9 and 0.22 of the helium-line variation. (auth)

13409 UNUSUAL RED GIANTS IN M5, M10, AND M92. Zinn, R. (Yale Univ. Observatory, New Haven). Astron. Astrophys.; 25: No. 3, 409-413(Jun 1973).

The stars that were reported to be unusual red giants in the globular clusters M5, M10, and M92 were observed spectroscopically at a dispersion of 130 Å/mm. The unusual star in M5 (IV-59) and the one in M10 (1018) have radial velocities that are consistent with cluster membership. New radial velocity data together with the available proper motion and photometric data indicated that the M92 stars are not cluster members, but are

field stars with normal compositions. The spectrograms of IV-59 and 1018 confirmed Osborn's earlier result that these stars have enhanced λ 4216 CN bands. The unusual strengths of their CN bands are not the result of low surface gravity, but are the result of unusual composition. There is evidence that the CN enhancement in IV-59 is at least partially caused by an over-abundance of carbon. It is suggested that the unusual compositions of IV-59 and 1018 were produced by the same mixing process that produced the carbon-rich atmospheres of the CH stars. (auth)

13410 CHEMICAL COMPOSITION AND THE LOCATION OF THE HYADES MAIN SEQUENCE IN THE COLOR–MAGNITUDE AND MASS–LUMINOSITY DIAGRAMS. Koester, D.; Weidemann, V. (Univ., Kiel). Astron. Astrophys.; 25: No. 3, 437-443 (Jun 1973).

A method is developed which serves to answer the question how far an observed metal over-abundance as measured by the atmospheric parameter [Fe/H] can be explained by lower original hydrogen content, X, or must be traced back to true metal enrichment, Z. Relative displacements of zero-age sequences of stars with changing X and Z in color–magnitude diagrams are calculated with atmospheric blanketing effects taken into account. Comparison with observation in the Hyades case, which is thoroughly rediscussed, yields—for [Fe/H] = +0.3 and Upton's (1971) values for the relative location of unevolved field stars with [Fe/H] = 0—a slight reduction of the original hydrogen content (X = 0.6) and a metal enrichment (Z = 0.035) as compared to a standard composition (X = 0.70, Z = 0.02). With van Altena's distance modulus m–M = 3.23, for which the Hyades white dwarfs fit the DA sequence, one obtains the most favorable compromise between all quantities observed. The mass–luminosity discrepancy is considerably reduced. (auth)

13411 PHOTOMETRIC STUDY OF NOVA DORADUS 1971A IN THE LARGE MAGELLANIC CLOUD. Ardeberg, A.; de Groot, M. (European Southern Observatory, Santiago de Chile). Astron. Astrophys.; 26: No. 1, 53-64(Jul 1973).

Photoelectric UBV photometry is presented for Nova Doradus 1971a in the Large Magellanic Cloud from observations on 51 nights during a period of 430 days. The observations extend from just at the principal luminosity maximum, corresponding to a visual absolute magnitude of –6.9, to an apparent visual magnitude of 21.5, corresponding to an absolute visual magnitude of +3.0. The light-curve parameters are deduced and discussed as well as the color curves. Comparisons are made with other novae in the Magellanic Clouds, with novae in M31, and with galactic novae. Nova Doradus 1971a is found to be of a fast to moderately fast type with three marked maxima. It also displays a very marked change of decline rate about 20 days after the principal luminosity maximum. A conspicuous plateau of approximately constant luminosity is present just after this change. The nova is very blue throughout its evolution in (B–V) as well as in (U–B). Different measures of radiation outburst energy are discussed. The type of outburst energy normally referred to is found to agree very well with those published for novae in M31 as well as for galactic novae. An estimate of the true bolometric radiation outburst energy is made. The maximum luminosity and the rate of fading are discussed. Using Nova Doradus 1971a as an independent distance indicator for the Large Magellanic Cloud, a distance modulus of 18.5m is obtained. The ejection of gas is discussed. A tabular summary of the principal parameters deduced is given. (auth)

13412 X-RAY BEAMING AND MASS TRANSFER IN HZ HER. Strittmatter, P. A. (Steward Observatory, Tucson, AZ); Scott, J.; Whelan, J.; Wickramasinghe, D. T.; Woolf, N. J. Astron. Astrophys.; 25: No. 2, 275-284(Jun 1973).

The optical and x-ray properties of HZ Her were analyzed within the framework of a model in which the primary is illuminated by x radiation from a degenerate secondary companion. System parameters were derived on the basis of a simplified model and yielded a minimum distance to HZ Her of ~5 kpc. It is shown that the x-ray pulses and 35 day on–off characteristics as well as the shape and modulation of the optical light curve can be understood if (i) the primary is illuminated by x-ray emitted in a beam fixed in a rotating neutron star secondary undergoing forced precession and (ii) energy is supplied by mass transfer from primary to secondary resulting in the formation of a disc around the x-ray source which contributes significantly to the total light. (auth)

13413 DIFFERENTIAL REDDENING IN THE OPEN CLUSTER IC 2581. Turner, D.G. (University of Western Ontario, London, Canada). Astron. J. 78: No. 7, 597-605 (Sept 1973).

Photometric UBV observations of the young open cluster IC 2581 have been reanalyzed to test the conclusion (Lloyd Evans 1969, 1972) that the data for this cluster indicate an error in the blue end of the standard zero-age main sequence. Since available spectroscopic data for the cluster and the surrounding region indicate the presence of differential reddening within the cluster and a reddening line for the region of slope 0.75, probable cluster members have been individually dereddened to eliminate this effect, and a variable-extinction analysis performed on the resulting data using ZAMS values of M_V. The results indicate an excellent fit of the IC 2581 data to the standard ZAMS, and a ratio of total-to-selective absorption for the cluster 5.5. Assuming that a value of R = 3 holds for the first $0^m.20$ in E_{B-V} the true distance modulus for the cluster is found to be 11.65 (2140 pc). A probable age for the cluster of about 10^7 is indicated, and the two supergiant members, HD 90772 (A7 Ia) and HD 90706 (B2.5 Ib), are found to be extremely luminous (M_V of – 8.65 and – 7.49, respectively). These last two findings are in agreement with Lloyd Evans' earlier results. (auth)

13414 NATURE OF THE PECULIAR EMISSION OBJECT V1016 CYGNI. Seaquist, E. R. (Univ. of Toronto); Gregory, P. C. Nature (London) Phys. Sci.; 245: No. 145, 85-87(8 Oct 1973).

A discussion is presented on interpretation of the radio emission from V1016 Cygni, which is regarded as a "peculiar emission object", discovered in 1965. Before an outburst that probably occurred before 1965 the spectrum of this object resembled that of an M star with Hα emission. Since that time this object has become an intense emission line object considerably brighter than its pre-outburst counterpart. In addition to the intense emission lines the object exhibits Balmer continuum radiation, that seems to be the dominant source of continuum emission, and also intense infrared emission possibly associated with circumstellar dust clouds. Reported flux densities and the observing frequencies are shown tabulated. An upper limit on the angular diameter of one arc sec at 8085 MHz has been set. The radio flux densities, taken together with the present available optical data, suggest that there is an extensive halo of hot gas surrounding the star. In the discussion presented it is suggested that matter is being continuously ejected to form such a halo. The radio spectrum was found to be remarkably linear with a slope of 0.75. The most direct interpretation is that the radiation is emitted by free-free emission from an optically thick gas cloud possessing a nonuniform density distribution, and this emission is roughly evaluated. A model is proposed. The overall optical results suggest that a continuing expansion occurs, with new material continuously ejected by the star to maintain the density, so that a more or less steady flow is produced. According to the proposed model the effective radius of the emitting region, and therefore the effective angular size, is dependent on the frequency; the expected angular size is then about 0.4 arc sec. at 8085 MHz, and 0.8 at 2695 MHz. The linear radius is estimated as 6×10^{15} cm, and the electron density as $3 \times 10^5/cm^3$. It is suggested that interferometer measurements be made at cm wavelengths in order to examine the dependence of angular size on frequency. The rate of mass loss is estimated to be $10^{-5} M_\odot/yr$, and is consistent with the existence of a strong stellar wind. It is finally suggested that V1016 Cygni may be an OH emission line star. (UK)

13415 ABSENCE OF COSMIC γ-RAY BURSTS IN ASSOCIATION WITH NORMAL STELLAR FLARES. Hudson, H.; Tsikoudi, V. (Univ. of California, San Diego, La Jolla). Nature (London) Phys. Sci.; 245: No. 145, 88-89(8 Oct 1973).

A search of OSO-3 data for γ-ray bursts, during times of known optical stellar flares, is reported. The observations provided no evidence for such bursts during normal stellar flares. The x-ray telescope used employed a NaI(Tl) scintillation counter. Eighty-one flares were surveyed. (UK)

13416 HETERODYNE DETECTION OF ARCTURUS AT 10.6 μm. Batz, B. D.; Granes, P.; Gay, J.; Journet, A. (Observatoire de Paris, Meudon, France). Nature (London) Phys. Sci.; 245: No. 145, 89-90(8 Oct 1973).

It is stated that heterodyne detection of Arcturus was achieved at 10.6 μm in April 1973 during observation at St. Michel Observatory, France. The experimental arrangement is described, and was based on the superimposition of coherent and incoherent beams achieved using a servomechanism working at 2.2μm. The local oscillator was a CO_2 laser working at 10.6 μm, and the detector was of the HgCdTe photovoltaic type. It is thought that atmospheric turbulence was responsible for some mismatching of the star and laser beams, causing a loss in the heterodyne signal, and this will be a handicap in future exploitation of the method; the work described, however, is a first step in the direction of heterodyne aperture synthesis in the infrared. (UK)

13417 NUCLEI OF PLANETARY NEBULAE AS HOT LIQUEFYING WHITE DWARFS. De Angelis, U.; De Cesare, L.; Foriani, A.; Platania, G. (Observatorio Astronomico de Capodimonte, Naples). Nature (London) Phys. Sci.; 244: No. 139, 133-135(27 Aug 1973).

It is stated that none of the recently proposed models for the central stars of planetary nebulae, before and after ejection of

mass, appears to be in good agreement with observations. The present masses of these central stars are not known, nor whether the amount of preplanetary mass loss is negligible or considerable. The following picture is here suggested: (i) the central stars of planetary nebulae in the diagonal branch of the H–R diagram are hot white dwarfs whose core is undergoing liquefaction; (ii) the cores of the stars are chemically pure and the envelopes are thin and composed of elements of mean charge $Z < 10$; (iii) the masses of the stars are in the range 0.45 to 1.3 $M_{\odot}$, which means that nebula ejection has to occur before the star reaches the diagonal branch, that is, in the horizontal branch; (iv) no neutrino luminosity is present and the cooling times are those for a gaseous core liquefying with emission of latent heat. This picture is based on latest results on gas–liquid phase transitions and the cooling of white dwarfs, which are briefly summarized. The following model is introduced for a hot white dwarf the core of which will eventually liquefy: an extended core, very dense and isothermal, where the electrons are completely diagnostic and relativistic, surrounded by a thin envelope where the temperature and density decrease towards the surface and the electrons are partially degenerate and partially relativistic. The dense core accounts for the total mass and luminosity of the star and is composed of pure C (or heavier elements) and the envelope acts as a thermal blanket, its opacity regulating the energy radiated by the hot core. Agreement was found between this model and previous calculations. (UK)

13418 OPTICAL PULSATIONS OF HZ HERCULIS. Cocke, W. J.; Hintzen, P.; Scott, J. S.; Worden, S. P. (Univ. of Arizona, Tucson). Nature (London) Phys. Sci.; 244: No. 139, 137(27 Aug 1973).

An attempt was made to detect optical variations in HZ Herculis, corresponding to its 1.2 sec x-ray pulsation period; no such variations were observed. The observations were made with the 229 cm telescope at the Steward Observatory, the instrumentation used being a conventional EMI 6256B phototube with a computerized pulse counting system. It is proposed that the observed optical pulses come directly from the x-ray source and are the low-frequency tail of the x-ray spectrum. (UK)

13419 β LYRAE PROBLEM. Kriz, S. (Astronomicky Ustav, Ondrejov, Czech.). Nature (London) Phys. Sci.; 245: No. 142, 36–37(17 Sep 1973).

It has been suggested that the secondary component of β Lyr is a black hole, but an alternative hypothesis is stated to be possible—β Lyr may be in the evolutionary phase of rapid mass exchange between components, the secondary being a massive main sequence star in rapid nonuniform rotation, embedded in a circulating gaseous flat disk. Further evidence is presented supporting such a hypothesis. It is stated that the most puzzling feature of β Lyr is the underluminosity of the secondary component, but it is shown that this was exaggerated previously. Additional information is needed before the luminosities of the components can be compared with the main sequence stars. The spectral type of the primary is B8. That of the secondary has been estimated as A–F on the basis of the photometric brightness ratio, but OAO observations suggest that the secondary is an early B star. Such a classification is supported by the presence of the emission lines of HeI in the spectrum of β Lyr, and it seems reasonable to adopt the spectral type BO–B2. The principal question seems to be not why is the secondary underluminous, but why is the primary overluminous, or in other words why is the less massive component more evolved. This is the classical evolutionary paradox of the Algol-like binaries, and as in the case of these binaries mass exchange seems to be the proper explanation. The black hole hypothesis cannot explain the overluminosity. (UK)

13420 DETECTION OF RADIO EMISSION FROM V1016 CYGNI. Purton, C. R.; Feldman, P. A.; Marsh, K. A. (York Univ., Toronto). Nature (London) Phys. Sci.; 245: No. 140, 5–6 (3 Sep 1973).

It is stated that the infrared excesses reported in many early-type emission line stars have been attributed to thermal re-radiation from circumstellar dust, with a contribution in some cases from free–free emission by circumstellar gas. If such gas is optically thin at cm wavelengths some of these objects should be detectable as radio sources. The detection of radio emission from V 1016 Cyg, which is a prominent infrared object of this type, is here reported. The observations were made at 2.8 cm (10.63 GHz) using the 46m Algonquin Radio Observatory telescope, together with a beam switching receiver. The experimental technique is described in detail. Radio emission was detected on three separate occasions, and flux densities recorded were 81 ± 11, 100 ± 20, and 85 ± 30 mfu, the weighted mean being 85 ± 10 mfu. It is stated to be reasonable to assume that the radio emission arises from free–free processes in circumstellar gas. Similar conclusions can be reached regarding the similar object HBV 475 (= V 1329 Cyg). (UK)

13421 RADIO EMISSION FROM HD167362 AND Vy2-2. Purton, C. R.; Feldman, P. A.; Marsh, K. A. (York Univ., Toronto). Nature (London) Phys. Sci.; 245: No. 140, 6–7(3 Sep 1973).

It is stated that many early type emission-line stars show a pronounced excess of infrared radiation; this may arise from thermal re-radiation by circumstellar dust, although in some cases the infrared spectra indicate that free–free emission by circumstellar gas may be the predominant mechanism. If such a gas is optically thin at cm. wavelengths some of these objects should be detectable as radio sources. Attempts were made to measure the radio emission from several such objects as a means of setting constraints on the latter hypothesis. Observations are here reported on HD 167362 and Vyssotsky 2-2, made at 2.8 cm (10.63 GHZ) with the 46 m Algonquin Radio Observatory telescope. Flux densities obtained for the former object, on several occasions, were 200 ± 24 and 198 ± 35 mfu, and for the latter object 115 ± 11 mfu and 107 ± 9 mfu, the appropriately weighted values being 200 ± 18 mfu and 110 ± 11 mfu. The measured radio flux density is comparable, in each case, with that in the near infrared. (UK)

13422 DETECTION OF RADIO EMISSION FROM M1-11 AND HD37806. Purton, C. R.; Feldman, P. A.; Marsh, K. A. (York Univ., Toronto). Nature (London) Phys. Sci.; 245: No. 140, 7(3 Sep 1973).

In continuation of earlier work the detection of radio emission from the objects M1-11 and HD 37806 is here reported. The observations were made at 2.8 cm. (10.63 GHz) with the 46m. Algonquin Radio Observatory telescope. Measured flux densities for M1-11, on three separate occasions, were 106 ± 17, 137 ± 25, and 123 ± 17 mfu, with an appropriately weighted mean value of 122 ± 11 mfu. This object appears to resemble Vy 2-2 and HD 167362 in some respects. If M1-11 has a radio spectrum similar to that of Vy 2-2 an appreciable fraction of its infrared excess may be due to free–free transitions in a circumstellar gas cloud. The measured mean flux density for HD 37806 was 44 ± 11 mfu, and this object appears in some respects to be more like V 1016 Cyg than like Vy 2-2, HD 167362 and M1-11. (UK)

13423 35-DAY CYCLE OF HZ HERCULIS. Chevalier, C. (Observatoire de Paris, Meudon, France); Ilovaisky, S. A. Nature (London) Phys. Sci.; 245: No. 145, 87–88(8 Oct 1973).

An investigation of HZ Herculis, the optical counterpart of Her X-1, by UBV photometry, from March to July 1973, using the 60 cm and 80 cm reflectors at Haute Provence Observatory, France, is reported. The observations showed that the light curve of HZ Herculis undergoes marked amplitude and shape changes that are well correlated with the 34.88 day cycle of Her X-1, and that the 35 day period remained unchanged, to an accuracy of ±1 day, over the above period. (UK)

13424 OBSERVATIONS OF NGC 6302 FROM 0.35 TO 20 MICRONS. Danziger, I. J.; Frogel, J. A.; Persson, S. E. (Harvard Coll. Observatory, Cambridge, MA). Astrophys. J.; 184: No. 1, L29–L32(15 Aug 1973).

Observations of NGC 6302 from 0.35 to 20 μ were made. From 3.5 to 20 μ there was a large excess of emission that can be attributed to dust particles heated by resonantly trapped Lα photons. The continuous emission from 0.35 to 2.2 μ can be accounted for by hydrogen and helium recombination emission at an electron temperature of 17,400°K. The value of the interstellar reddening constant C was determined to be 1.0 ± 0.1. When combined with previous results, this work shows that NGC 6302 is similar to the nebula NGC 7027 in several respects. (auth)

13425 THERMAL STABILITY OF PURE CARBON STAR. Paczynski, B. (Inst. of Astronomy, Warsaw). Astron. Astrophys.; 26: No. 2, 291–295(Jul 1973).

Models of pure carbon stars with and without neutrino emission are presented. Models are located on the carbon main sequence which consists of normal (N), high density (HD), and white dwarf (WD) branches. HD models are found to be thermally (i.e. secularly) unstable, while N and WD models are thermally stable. It is shown that thermal eigenvalues can be ordered in a natural way even when they are complex. (auth)

13426 WATER MASERS IN A PROTOSTELLAR GAS CLOUD. de Jong, Teije. (Sterrewacht, Leiden). Astron. Astrophys.; 26: No. 2, 297–313(Jul 1973).

Population inversion of the $6_{16}-5_{23}$ transition of water molecules is a natural consequence of the breakdown of thermal equilibrium in the outer layers of a dense gas cloud. Approaching the surface of the cloud from below, radiation of different lines starts to escape at different depths. Energy is continuously pumped into the lines since the molecules are coupled to the reservoir of kinetic energy of the gas by collisions with hydrogen

molecules. In support of this picture the transfer of line radiation in a gas containing model water molecules with thirty-one pure rotational levels was calculated. Two simple approximations of H_2-H_2O collisional cross sections were used: (A) The cross sections were assumed to be proportional to the square of the matrix elements of the dipole transitions; (B) All cross sections were assumed to be equal to the geometrical cross section, still following dipole selection rules. Population inversion of the $6_{16}-5_{23}$ transition occurred for both collisional models since the breakdown of thermal equilibrium is governed by the line opacities. The required amplification could only be produced in case (A). The level populations of some other transitions of water become also inverted. One particular class of molecular maser sources could be produced by "limb brightening" in the "cocoon" around new born O stars. This may explain the observed coincidence with "bright knots" in the continuum radiation of H II regions. (auth)

13427 RR LYRAE VARIABLES IN BAADE'S FIELD NEAR NGC 6522. Plaut, L. (Univ., Groningen, Netherlands). Astron. Astrophys.; 26: No. 2, 317-319(Jul 1973).

Periods of all RR Lyrae variables in Baade's field near NGC 6522 ($l = 1.0°$, $b = -3.9°$) were redetermined. The space distribution of these stars was derived. The maximum density was found at a distance of 8.3 kpc. (auth)

13428 EVOLVING MODELS FOR CONTACT BINARIES. Vilhu, O. (Univ. of Helsinki). Astron. Astrophys.; 26: No. 2, 267-274(Jul 1973).

Evolution of some contact systems with a total mass of $1.8M_\odot$ was followed numerically. The initial parameters were chosen so that the contact system is formed during the rapid mass exchange phase of Case A evolution. The further evolution was calculated by determining the mass and energy exchanges between the components from the condition that both stars fill their Roche lobes. The systems evolve with increasing mass-ratios and with increasing amounts of luminosity transferred from the primary to the secondary, which confirms the recent results of Biermann and Thomas (1973). For the contact time scale the nonhomogeneity of the secondary was found to be important. Although the models calculated may represent some observed systems, the majority of W UMa type systems with nearly equal effective temperatures in both components cannot be explained by these evolving models, together with the energy transfer picture used, alone. Finally, the importance of the outer layers in making the secondary hotter is demonstrated by using some numerical experiments which confirm the results of Whelan (1972) and Biermann and Thomas (1973). (auth)

13429 ADAPTATION OF THE STROEMGREN FOUR-COLOR SYSTEM TO PHOTOGRAPHIC PHOTOMETRY. Schreur, J. J. (Steward Observatory, Tucson, AZ). Astron. Astrophys.; 26: No. 2, 263-266(Jul 1973).

A system of four-color photographic photometry, which closely mimics the four-color system of Strömgren, is presented. There appear to be no systematic differences between the two systems for stars with $(b-y) \leq 0.45$. Because the photographic violet filter is not an ideal match to the photoelectric violet filter, a correction must be made to the m_1 and c_1 indices for stars with $(b-y) > 0.45$ in order to fit them to the Strömgren system. A correlation is found between metallicity and δm_1, and between luminosity and δc_1 for late type stars. (auth)

13430 LIGHT CURVES OF THE GRAVITATIONAL LENS-LIKE ACTION FOR BINARIES WITH DEGENERATE STARS. Maeder, A. (Observatoire de Geneva). Astron. Astrophys.; 26: No. 2, 215-223(Jul 1973).

The gravitational lens-like action of a star is examined and expressions giving a complete representation of the light curves produced by this effect are obtained. The case of binaries which require new developments is especially considered, but the usual case of 2 stars very distant from each other is also given in the Appendix. It is to be noted that the case of binaries is the only one which may give reproducible lens effects. The various conditions for visibility of the lens action are also discussed and the relations between the orbital periods of binaries, the geometrical probability of occurrence of the lens action, the duration of the effects and their amplitude are established for various kinds of binaries. Lens actions for binaries, which contain at least one main-sequence star, have a very small probability to be observed. But, binaries consisting of two white dwarfs, or of a white dwarf with a neutron star or a black hole, have, if they exist, a geometrical probability to produce gravitational flashes of a given amplitude from 25 to 10^4 times larger than main-sequence stars. The lens action would give quite a reasonable chance to observe black holes in such degenerate systems, if there is a path in stellar evolution leading to them. Stellar radii could also be estimated by the lens effect. (auth)

13431 TIME DEPENDENT RADIATIVE TRANSFER. III. Development of the Formalism. Froeschle, C. (Observatoire de Nice). Astron. Astrophys.; 26: No. 2, 229-236(Jul 1973).

The formalism of previous studies is developed (exponential damping of harmonic temperature fluctuations in an infinite homogeneous atmosphere). The method is applied to a gray medium, then to a monochromatic problem. The previous results are confirmed. In particular it appears that in both cases, there are only three physically different types of homogeneous perturbations. In the case of an optically thick perturbation, the damping time is of the form: $t_D = N(t_F + t_R)$, where N is the mean number of scatterings undergone by a photon leaving the medium, t_F is the mean time of flight, and t_R a "time of regeneration" that is defined. (auth)

13432 STRUCTURE OF HELIUM BURNING REGIONS IN STARS: DEPENDENCE ON MOLECULAR WEIGHT AND BURNING RATES. Lauterborn, D. (Univ. of Colorado, Boulder). Astron. Astrophys.; 26: No. 2, 191-196(Jul 1973).

It is shown that the luminosity of a helium core is nearly independent of the burning rates; a change of ten orders of magnitude in the burning rates changes the luminosity by only about 3%. Changes in the chemical composition (helium into carbon and oxygen), on the other hand, have large effects. Also, models with two burning regions react strongly on changes in the burning rates; for such models, triple solutions may occur. One of the solutions is argued to be secularly unstable. (auth)

13433 SPECTROGRAPHIC OBSERVATIONS OF THE PECULIAR Be STAR WITH INFRARED EXCESS HD 45677. Swings, J. P. (Inst. of Astrophysics, Cointe-Ougree, Belgium). Astron. Astrophys.; 26: No. 3, 443-455(Aug 1973).

The following spectrographic information concerning the peculiar Be star HD 45677 (B2e,$m_v \sim 8.5$) is presented: (i) the forbidden emission lines ([O I], [S II], [Fe II], [Ni II], [Cr II], . . .) are single and sharp; (ii) the double emission lines of permitted Fe II seem to originate in a thin equatorial ring well separated from the stellar photosphere; (iii) the Ti II, Mn II and Cr II lines appear as very broad (or double) emissions with a central sharp absorption (shell or thick ring); the Fe II profiles were similar to those of the metallic lines in the 1940's but have evolved differently since; (iv) the stellar Mg II absorption line $\lambda 4481$ and the circumstellar Ca II K line are shown to be variable; (v) the complex structure of H_γ and H_δ (P Cygni with several emission- and absorption components over a wide shallow absorption) varies from night to night; (vi) in the course of a single night, the profiles of H_γ and H_δ varied on a time scale of about two hours, one absorption component disappearing completely. A line list covering the region 3100 to 8700 Å is given, together with a comparison between some emission lines present in HD 45677 and in other peculiar objects, such as η Carinae or LkHα 101. (auth)

13434 LOW-MASS MAIN-SEQUENCE: THE COMPARISON BETWEEN THEORY AND OBSERVATION. Hoxie, D. T. (Univ. of Nebraska, Lincoln). Astron. Astrophys.; 26: No. 3, 437-441 (Aug 1973).

A comparison between theoretical zero-age main-sequence stellar model calculations and the observational data derived from nearby stars is undertakon in the mass-luminosity and mass-radius planes for stars of less than solar mass. It is found that, although theory succeeds in representing the empirical low-mass mass-luminosity relation, there is a discordancy between theory and observation in the mass-radius plane for stars of mass less than $0.5\ M_\odot$. This discordancy, which is comparable to the estimated observational uncertainty, is such that the theoretical radii are 30 percent or more smaller than the observationally derived radii. Although the large empirical uncertainty renders the significance of this discordancy questionable, it is speculated that a systematic underestimation of effective temperatures along the very late main-sequence may be partially responsible. (auth)

13435 LIGHT VARIATION OF PECULIAR A-TYPE STARS. Kodaira, K. (Univ., Heidelberg). Astron. Astrophys.; 26: No. 3, 385-395(Aug 1973).

By examining the published data of forty-nine periodic variables among Ap stars, it is suggested that the light variations of these stars are mainly caused by the variable abundances of the chemical elements, supporting the working hypothesis by Wolff and Wolff (1971). It is shown by simple model calculations that the variable line-blanketing effect is capable of inducing the light variations as observed. Consequences of the conclusions upon the oblique-rotator hypothesis are also briefly discussed. (auth)

13436 ECLIPSING CONTACT BINARY VW CEPHEI. van't Veer, F. (Inst. of Astrophysics, Paris). Astron. Astrophys.; 26: No. 3, 357-363(Aug 1973).

This study of the eclipsing contact binary VW Cep was mainly

based on the observational material collected by Kwee (1966a, b), during the years 1957–1959. New minimum times were calculated according to different polynomial solutions for primary and secondary minima. The so-called Kwee-effect is interpreted as the consequence of gas flows from regions in the neighborhood of the first Lagrangian point to the outer envelope of the system. The long term period variation is briefly discussed. (auth)

13437 DISTANCES OF 26 STARS OF THE STELLAR RING 58. Kolesnik, L. N. (Main Astronomical Observatory, Kiev); Voroshilov, V. I.; Uranova, T. A. Astron. Astrophys.; 26: No. 3, 353-356(Aug 1973).

The BV-magnitudes and spectral classes for 720 stars in the region 2° × 2° around the stellar ring 58 were determined. Color excesses E_{B-V} were plotted as a function of the uncorrected distance modulus $V-M_v$. The amount of the interstellar absorption in the field and spectrophotometric distances of 26 stars of the ring were determined. The stars are located at various distances from the Sun: $4.3^m \leq V_O - M_v \leq 12.1^m$, $70pc \leq r \leq 2630$. Members of the stellar ring 58 do not form a physical group. The ring appears to be a result of projection of stars at different distances from the Sun on the plane of the sky. (auth)

13438 TEMPERATURE ASPECTS OF LANDAU ORBITAL FERROMAGNETISM IN WHITE DWARFS AND NEUTRON STARS. Schmid–Burgk, J. (Univ., Heidelberg). Astron. Astrophys.; 26: No. 3, 335-341(Aug 1973).

Landau orbital ferromagnetism (LOFER) has been invoked to explain 10^7 Gauss magnetic fields in white dwarfs and 10^{12} Gauss fields in neutron stars. The extent is investigated to which this mechanism can operate at nonzero temperatures in those situations in which electron-lattice interactions are not of dominating importance (these interactions require specific assumptions about crystal structure, purity of sample, field-lattice alignment etc. to which the mechanism is very sensitive). An exact treatment of the temperature dependence of LOFER for a relativistic gas of free electrons shows that the limiting temperature, T_c, for white dwarfs is around a few 10^3 °K, while for neutron star densities T_c is as low as a few 10^4 °K. The results for the model of free electrons are modified by electron–electron interactions. An analysis incorporating such interactions but now restricted to the nonrelativistic regime leads to white-dwarf minimum fields several orders of magnitude larger than the observed value of 10^7 Gauss for $T \geq 10^4$ °K. T_c is also increased by orders of magnitude. T has to reach very low values before it permits 10^7 Gauss fields. It is therefore concluded that no direct correlation between magnetic fields presently observed and LOFER models can be established, provided lattice effects are not dominant. (auth)

13439 EIGENVALUE PROBLEM IN THE KINEMATIC APPROACH TO DYNAMO THEORIES OF COSMIC MAGNETISM. Yabushita, S. (Kyoto Univ.). Astron. Astrophys.; 26: No. 3, 321-324(Aug 1973).

One approach to kinematic dynamo theory is the search for an eigenvalue h of positive real part in the equation $\nabla^2 H + R\ \mathrm{rot}\ (u \times H) = hH$, where the fluid velocity u is a given function of position and R denotes the magnetic Reynolds number. By using the Bullard–Gellman method of expanding magnetic fields into spherical harmonics, eigenvalues were computed for a Bullard–Gellman velocity field using a crude numerical approximation. When the number of the harmonics retained in the magnetic field is fixed, the real part of the first eigenvalue tends to increase with R. In order to examine the convergence, the eigenvalue problem was solved numerically by taking various numbers of harmonics up to seventeen. The velocity field does not give convergent eigenvalues within the limits of the computations carried out. Three other velocity fields were also similarly examined: (i) a modified Bullard–Gellman field; (ii) Lilley's field; (iii) a modified Lilley's field. These all also give eigenvalues with positive real parts at certain values of R, but the eigenvalues do not appear to converge when the number of harmonics retained is increased. (auth)

13440 EVOLUTIONARY SEQUENCE FOR DA, DB, DC WHITE DWARFS. Baglin, A. (Observatory, Nice); Vauclair, G. Astron. Astrophys.; 27: No. 2, 307-315(Sep 1973).

A simple evolutionary scheme is proposed with the hydrogen content as the only parameter. If this content is 0, the white dwarf evolves directly from DB to DC type through its cooling sequence. If not, the external layer of pure hydrogen, floating at the surface of the star when it is of DA type, becomes convectively unstable around 15000°K. For a critical effective temperature, which is lower when the hydrogen content increases, the whole hydrogen region becomes convective and the mixing of the external hydrogen with the inner helium forces the star to appear as a DB type or a DC type. This process of mixing by convection does not allow a DA type white dwarf to become as hot as the hottest DB types (18000°K). So, it is concluded that stars evolve toward the white dwarf stage either with a small amount of hydrogen left or not. (auth)

13441 LINEAR POLARIZATION IN THE ORION NEBULA. Feibelman, W. A. (Goddard Space Flight Center, Greenbelt, MD). Astron. Astrophys.; 27: No. 2, 317-318(Sep 1973).

Photographs of the central portion of the Orion Nebula indicate small variations in polarization as a function of rotation of the polarizing filter. The effects are observed only in an area east of the Trapezium and only in the red region of the spectrum. (auth)

13442 INTERPOLATION METHOD FOR THE SOLUTION OF NON-LTE LINE TRANSFER PROBLEMS. Gehren, T. (Univ., Kiel). Astron. Astrophys.; 27: No. 2, 291-295(Sep 1973).

Iterative procedures solving non-LTE line transfer problems through the integral equation approach require the calculation of monochromatic λ operators. A simple interpolation method is outlined that avoids the repeated evaluation of exponential integrals. Based on polynomial approximation of the source function, gaussian integration weights and divisions have to be calculated only once for a set of τ-points. While saving more than $^3/_4$ of computing time, first solutions of multilevel line transfer problems indicate that the accuracy is comparable to other methods. (auth)

13443 VARIABLE dMe STARS. Torres, C. A. O.; Ferraz Mello, S. (Aeronautics Inst. of Tech., Sao Jose dos Campos, Brazil). Astron. Astrophys.; 27: No. 2, 231-236(Sep 1973).

Periodic variations in the dMe stars may be well represented by simplified models of nonuniform brightness distribution (spot model). The spots must be a few percent of the total star surface area and must be a few hundred degrees cooler than the surface temperature. The V and R observations of AU Mic (HD 197481) are fitted by a two-spot model. The total spotted area is 10.3 percent of the whole surface and it is assumed to be 500°K cooler than the star surface. The difficulties which arise for the shorter wavelengths may be overcome by assuming that the spots radiate like main-sequence stars of spectral type M 1 or M 2. The residues, while small, lead to suspicion of the existence of some correlation among spotted area and ultraviolet activity. The grey veil model is also discussed with emphasis on stability problems. (auth)

13444 TURBULENT STRESS AND THE STRUCTURE OF YOUNG CONVECTIVE STARS. Prentice, A. J. R. (Carnegie–Mellon Univ., Pittsburgh). Astron. Astrophys.; 27: No. 2, 237-248(Sep 1973).

It is pointed out on the basis of T Tauri star observations that there may exist strongly supersonic turbulent stresses beneath the surfaces of young convective stars which are of order 100 times the normal gas pressure. To account for this phenomenon an elementary dynamical theory of supersonic turbulent convection is presented which is an extension of the usual subsonic mixing-length theory. (WDM)

13445 MODEL TO EXPLAIN ALTERNATE PERIOD CHANGES IN ALGOL-LIKE BINARIES. Biermann, P. (Columbia Univ., New York); Hall, D. S. Astron. Astrophys.; 27: No. 2, 249-253 (Sep 1973).

Following the ideas of Smak (1972) on period changes in U Gem systems, a model is developed to explain the alternate period changes in Algol-like binaries. The model is based on the hypothesis that sudden bursts of mass are transferred to the hot star as a result of an instability probably of Bath's (1972) type. These bursts cause angular momentum to be stored temporarily as rotation in the outer 10^{-5} $M_\odot$ or less of the hot star (thereby decreasing the period) and then to go back to the orbit as increased turbulence lets the friction time scale catch up with the dynamical time scale of the mass transfer (thereby increasing the period). Equations are given for the two phases of this cycle (period decrease and increase) and also for the long-term average period increase. These equations are used to analyze a segment of the O–C diagram of U Cep (Svechnikov, 1955) and derive the mass flow rate of each burst occurring within this segment. The sum of all the mass bursts seems to be greater than the rate of mass transfer implied by the longterm parabolic period increase. The implications of this discrepancy are discussed, and further observations which can test our model are suggested. (auth)

13446 CHERENKOV RADIATION AS A STANDARD SOURCE FOR ROCKET EXPERIMENT. Sua, C. T. (Laboratoire d'Astronomie Spatiale, Marseille). Astron. Astrophys.; 27: No. 2, 255-260(Sep 1973). (In French).

The accuracy of stellar energy measurements in the ultraviolet depends upon a fundamental radiation source. One method consists of calibrating rocket payloads before and after flight,

using the synchrotron radiation. However, in order to avoid systematic errors due to possible changes of various components (reflectance of telescope, filter transmission, etc. . .), it would be better to calibrate (photographic or photoelectric) receivers during the flight, under the same environmental conditions as for the stellar observations. This is possible by using Cherenkov radiation as a standard source since it needs not a power supply. Furthermore, its energy distribution is given by Frank and Tamm theory. A description of a rocket calibration source is given. In the spectral region 2400 to 5000 Å, the Cherenkov radiation is calibrated absolutely by comparison with a tungsten ribbon lamp of known absolute intensity. (auth)

13447 EFFECT OF THE ABSORBERS UPON THE THERMAL STRUCTURE OF A LTE ATMOSPHERE, HYDROGEN, AND HELIUM. Dumont, S.; Heidmann, N. (Institut d'Astrophysique, Paris). Astron. Astrophys.; 27: No. 2, 273-279(Sep 1973).

It is shown that in a LTE model atmosphere there is a temperature rise in the very superficial layers if two conditions are fulfilled: (1) a change of absorbing ion at the surface must induce a change in the frequency dependence of the absorption coefficient; (2) this change should be such that the ratio κ_2/κ_1 of the absorption coefficient κ_2 at the frequencies where $J_\nu > B_\nu$ over the absorption coefficient κ_1 at the frequencies where $J_\nu < B_\nu$ increases. In an atmosphere with only H and He as absorbers, these conditions exist in models with T_{eff} from 5000 to 8000 K. Those models are almost grey in the deep layers because the absorber H^- dominates, but in the transparent layers the dominating absorber is neutral H. This change induces a jump in the absorption coefficient at the frequency of the Balmer discontinuity close to that where the radiative flux is maximum. So, in those cases, it is the Balmer discontinuity which controls the temperature at the surface. (auth)

13448 ORBIT OF THE DOUBLE-LINE SPECTROSCOPIC BINARY HD 126983. Kaufmann, J. P.; Klippel, E. (Technische Univ., Berlin). Astron. Astrophys.; 27: No. 3, 469-472(Sep 1973).

More than 20 sharp lines of the two components of the spectroscopic binary HD 126983 were measured on 11 coudé-spectra, yielding a period of 11.82 days. The two components are of the same spectral type A2V with only slightly different masses. The projected equatorial rotational velocity is small ($v_e \cdot \sin i < 15$ km/s). Though HD 126983 seems to belong to the early A analogues of the Am stars, the indicator of metallicism suggested by Conti (1965), i.e. a low value of the ratio Sc II λ 4246/Sr II λ 4215, was not verified. The spectroscopic data were used to predict orbital inclination and semimajor axes. (auth)

13449 STABILITY OF ROTATING SUPERMASSIVE STARS. Bisnovaty-Kogan, G. S.; Ruzmaikin, A. A. (Inst. of Applied Mathematics, Moscow). Astron. Astrophys.; 27: No. 2, 209-221 (Sep 1973).

Supermassive stars (those with $M \geq 10^5\ M_\odot$) are maintained in equilibrium by their radiation pressure. However, when first order general relativistic effects are taken into account, such stars are seen to be unstable against collapse, and rotation can become the most important means of establishing their stability: in this paper this is investigated by adding to the usual expressions for the full mass–energy, rest mass, and angular momentum deviations arising from the second order post-newtonian corrections of general relativity in stationary, rotating configurations. These corrections are obtained by expanding the exact Einstein expressions to order $1/c^4$. The approximate "energy" method is then used to study stability against collapse; the energy functional is written in terms of two parameters–ρ_c, the central density, and α, a measure of oblateness–and its first and second variations define the state of the star. When the first variation vanishes, the star is in equilibrium, and if the second is positive it is also stable. It is found that: $J^2 > J_1^2 = 0.19(2GM_\odot^2/c)^2$ leads to stable equilibrium; when $J_1^2 < J^2 < J_2^2 = 0.35(2GM_\odot^2/c)^2$ the star in the course of time becomes unstable against collapse; when $J^2 > J_2^2$ the star eventually forms itself into a thin disc. The results are applied to a model of a quasar. (auth)

13450 OBSERVATIONS IN LINEARLY POLARIZED LIGHT OF THE INTENSITY OF THE DIFFUSE λ 6180 ABSORPTION BAND IN 49 O, B, AND A STARS. Gammelgaard, P.; Rudkoebing, M. (Univ. of Aarhus, Denmark). Astron. Astrophys.; 27: No. 2, 261-271(Sep 1973).

A narrow-band photoelectric index of the intensity of the diffuse interstellar absorption band at λ 6180 was measured in its dependence on the state of linear polarization of the light in 49 early-type stars in the northern Milky Way. An effect of differential continuous polarization was eliminated in a first approximation with the aid of the observational results for two stars in VI Cyg. The λ 6180 band absorption indices tend to have maximum for electric vector position angles about orthogonal to those that correspond to maximum of absorption connected with continuous polarization. The dependence on galactic longitude of the λ 6180 index, expressed in units of the λ 4430 index, was found to be systematically different in two parts of the galactic plane. This may be interpreted in terms of a change in direction of the magnetic field at the inner boundary of the outer spiral arm. (auth)

13451 ANALYSIS OF THE ULTRAVIOLET SPECTRUM OF A-TYPE STARS OBSERVED BY THE OAO II SATELLITE. Gros, M. (Inst. of Astrophysics, Paris); Sacotte, D.; Praderie, F.; Bonnet, R. M. Astron. Astrophys.; 27: No. 2, 167-181(Sep 1973).

Observations of μ Lep, γ Gem, α C Ma, β Aur, β U Ma, β Car, α Dra obtained by the Wisconsin Experiment Package on the OAO II satellite are reduced to obtain the ultraviolet energy distribution of these stars. For each star, with the help of classical model atmospheres, theoretical and observed ultraviolet spectra are compared. An explanation is offered for the nonobservation of the Si I 1520 Å photoionization discontinuity by studying the evolution of the synthetic spectrum in this spectral range with temperature and abundances. In the range 2200 to 2500 Å it is found that the theoretical fluxes tend to be larger than the observed ones; it is suggested that a continuous or pseudocontinuous opacity could be present for stars as hot as the A0 type. By comparison between the observed and the synthetic spectra some line identification is performed between 1000 and 3000 Å. The line blocking between 2300 and 3000 Å for α C Ma is estimated. (auth)

13452 ORBITS AND INTEGRALS OF MOTION FOR OLD GALACTIC POPULATION STARS. II. Periodic and Nonperiodic Orbits in the 2nd Schmidt Potential. Mayer, F.; Martinet, L. (Observatory, Geneva). Astron. Astrophys.; 27: No. 2, 199-208(Sep 1973).

Preliminary to a comparative study of orbits in various slightly different galactic potential models, results of a systematic exploration of m-periodic orbits in the 2nd Schmidt potential (1965) (an m-periodic orbit closes after making m oscillations along the z-axis and n oscillations along the ϖ-axis in the meridian plane) are presented. (WDM)

13453 CORRELATION BETWEEN ULTRAVIOLET EXCESS AND DEVIATION FROM THE MEAN MAIN-SEQUENCE. Gliese, W. (Astronomisches Rechen-Institut, Heidelberg). Astron. Astrophys.; 27: No. 3, 429-431(Sep 1973).

For main-sequence stars with $B - V > +0.45$ an obvious correlation exists between the ultraviolet excess and the deviation from the mean (M_V, $B - V$) relation. The question is whether or not absolute magnitudes determined from this color–luminosity relation can be significantly improved by addition of a linear term $\Delta M = b\delta(U - B)$. Coefficient b proves to be depended on the photoelectric system and, furthermore, it is very sensitive to the accidental errors in the color observations. For the 35 M dwarfs with U, B, V measured by Johnson the addition of ΔM to the color–luminosity relation diminishes the subsequent dispersion of the deviations by about 60%. (auth)

13454 FAST ROTATION OF METAL-POOR STARS. Mullan, D. J. (Bartol Research Foundation of The Franklin Inst., Swarthmore, PA). Astron. Astrophys.; 27: No. 3, 379-381(Sep 1973).

Mass loss in stellar winds is expected to be a sensitive function of maximum convective velocity in the outer convection zone of stars. Metal-poor stars are expected to have low mass loss rates, and therefore their rotational velocities are not braked as efficiently as are those of metal-rich stars. This explains an observational correlation described by Danziger and Faber (1972). (auth)

13455 MASS LOSS FROM ROTATING STARS. Weidelt, R. D. (Ruhr-Univ., Bochum, Ger.). Astron. Astrophys.; 27: No. 3, 389-394(Sep 1973).

The mass loss from stars due to continuous outflow of matter from a hot corona is considered. The dependence of flow velocity and mass loss on the rate of rotation is investigated. The mass loss is found to increase faster than exponentially with increasing rotational energy (within a set of otherwise identical models). The gas can show deceleration if the rotation is high enough, which might give an explanation for T Tauri star observations. Comparing the appropriate time scales of the plasma the range of application of the one-component fluid model is obtained. (auth)

13456 LONG TIME VARIATIONS OF THE SHELL STAR 88 HERCULIS. Doazan, V. (Observatoire de Paris). Astron. Astrophys.; 27: No. 3, 395-398(Sep 1973). (In French).

The observations of 88 Her made since 1958 show that the lines of Ti II, Cr II, Si II, Mg I, and Fe II started to disappear in 1970. The intensity of the Hα and Hβ emissions has considerably diminished over the same period. The only envelope absorption lines visible in 1972 are those of hydrogen. If one supposes that this phenomenon is periodic, the period cannot be less than 15

years. The spectral variations are not related to the radial velocity curve determined by Harmanec et al. This indicates that they are independent of the possible binary nature of 88 Her associated with a much shorter period (88.4 d). (auth)

13457 CALIBRATION OF LUMINOSITY CRITERIA FOR G AND K GIANTS BY MEANS OF TRIGONOMETRIC PARALLAXES. Hansen, L. (Copenhagen Univ. Observatory). Astron. Astrophys.; 27: No. 3, 355-360(Sep 1973).

Trigonometric parallaxes are shown to contribute sufficient information to yield consistent luminosity calibrations for G8–K3 giants. Calibrations of the absolute visual magnitude, M_V, in terms of the narrow-band indices n, k, m, and f are obtained. The consistency only applies to luminosities derived from trigonometric parallaxes. A comparison reveals a disagreement with $M_V(K)$. A recalibration of $M_V(K)$ based on trigonometric parallaxes gives $M_V = 0.8 \cdot M_V(K)$ for the G8–K3 giants. (auth)

13458 UBV PHOTOELECTRIC PHOTOMETRY OF THE MAGNETIC VARIABLE STAR HD 133029. Degewij, J. (Sterrewacht Leiden). Astron. Astrophys.; 27: No. 3, 473(Sep 1973).

Photoelectric UBV observations of the magnetic variable star HD 133029 are presented. It is questionable whether the star is photometrically variable. (auth)

13459 MULTIPLE SOLUTIONS OF THE EQUATIONS OF STELLAR STRUCTURE. II. E Model Sequences. Lauterborn, D. (Univ. of Colorado, Boulder). Astron. Astrophys.; 27: No. 3, 323-329(Sep 1973).

E model sequences with different total mass, core mass, mixing length, profile type, chemical composition, and central luminosity are presented. The range where triple solutions occur increases with increasing total mass and decreasing mixing length, while the other parameters are of minor importance. A case of five solutions for E models is encountered. The validity of a "restricted" and a "local" version of the Vogt–Russel theorem is discussed. (auth)

13460 LIGHT VARIATION OF THE DELTA SCUTI VARIABLE HR 1287. Kesikachary, K. (Univ. of Western Ontario, Can.). Astron. Astrophys.; 27: No. 3, 331-335(Sep 1973).

Blue photometric observations of the δ Scuti variable HR 1287 made on 12 nights are presented. There is a discrepancy in the fundamental frequency as obtained from the times of maxima and minima and the periodogram analysis, the values obtained by the two methods being 7.902 c/d and 6.899 c/d respectively. These two possibilities give rise to a secondary frequency of 7.453 c/d and 9.560 c/d respectively. A detailed discussion based on the window synthesis technique is presented to show that 6.899 c/d, 9.560 c/d give much better fit to the data than the other set of frequencies, and the method of maxima and minima incorrectly picks up an alias of 6.899 c/d as the fundamental frequency. From the variation of nightly mean magnitudes a long period of about 60 days is suggested. (auth)

13461 HYDRODYNAMIC MODEL CALCULATIONS FOR SUPERMASSIVE STARS. III. Collapse and Explosion of a Slowly Rotating 7.5×10^5 $M_\odot$ Object. Schmidt, J. (Univ.-Sternwarte, Goettingen, Ger.). Astron. Astrophys.; 27: No. 3, 351-354(Sep 1973).

The dynamical evolution of a slowly rotating 7.5×10^5 $M_\odot$ supermassive star is followed by numerically solving the general relativistic hydrodynamic equations. In contrast to the zero angular momentum case the rotating star does not become a black hole, but, rather the HCNO-burning builds up enough pressure to halt and reverse the collapse into a violent explosion. In general, the slowly rotating 7.5×10^5 $M_\odot$ object behaves like a nonrotating supermassive star of smaller mass. However, the reversal of the collapse takes place much more smoothly than in nonrotating objects and, in particular, no shock front is formed during the explosion of the slowly rotating 7.5×10^5 $M_\odot$ object. (auth)

13462 BEAT PERIOD AND CHARACTERISTICS OF CY AQUARII. Fitch, W. S. (Univ. of Arizona, Tucson). Astron. Astrophys.; 27: No. 1, 161-162(Aug 1974).

Analysis of published observations shows that the dwarf Cepheid CY Aquarii, with $P_0 = 0.061038$d, has a beat period of probable length 0.17766d. Interpretation consistent with present theory then suggests that the first overtone period $P_1 = 0.04543$d, that $P_1/P_0 = 0.7443$, and that CY Aqr has a heavy element composition $Z \approx 0.02$ to 0.03 with a near normal mass. The data are insufficient to permit very firm conclusions. (auth)

13463 STELLAR CHROMOSPHERIC VELOCITY FIELDS AND THE WIDTH LUMINOSITY RELATIONS. Fosbury, R. A. E. (Royal Greenwich Observatory, Herstmonceux, Eng.). Astron. Astrophys.; 27: No. 1, 129-141(Aug 1974).

The chromospheric width-luminosity relations observed for Hα and the Ca II and Mg II resonance lines are discussed. New electronographic observations of the Hα line width in 33 late-type stars are presented and it is shown that these measures are consistent with the nonthermal broadening velocities deduced from the Ca II lines if thermal Doppler broadening with $T_e \sim 6000$°K for the hydrogen line is included. The differences in width between the Ca II and Mg II lines are interpreted in terms of the increase in nonthermal or microturbulent broadening velocity with height in a chromosphere. Both the magnitude and the ratio of these line widths in the Sun are shown to be in good agreement with those expected from existing empirical and semi-empirical estimates of the acoustic energy flux necessary to heat the chromosphere and corona. It is suggested that if suitable chromospheric density scaling laws can be found, the width-luminosity relations provide a semi-empirical method of tracing the magnitude of the mechanical energy flux over the cooler part of the HR-diagram. (auth)

13464 UV INTERSTELLAR ABSORPTION LINES IN THE SPECTRUM OF γ^2 VEL. Grewing, M. (Univ., Bonn); Lamers, H. J.; Walmsley, C. M.; Wulf-Mathies, C. Astron. Astrophys.; 27: No. 1, 115-118(Aug 1974).

Interstellar absorption lines seen in the 2060 to 2160 Å, 2495 to 2595 Å, and 2775 to 2875 Å bands of the spectrum of γ^2 Velorum, observed by the Orbiting Stellar Spectrophotometer S 59 were analyzed by the curve of growth method. The physical conditions in the direction towards the Gum Nebula are discussed. Two models for the interstellar gas along the line of sight, with a velocity dispersion of 3 and 13 km/s respectively, are considered and the results are compared with other observations. The second model seems to be the most realistic one. In this case, most of the gas along the line of sight is ionized. The electron density in the region where the lines are formed is estimated to be less than 2 cm^{-3}, and a value of 0.1 cm^{-3}, consistent with pulsar dispersion results, seems plausible. Both magnesium and iron seem to be depleted relative to the solar abundance by a factor of about 100. (auth)

13465 MASSES OF DOUBLE MODE CEPHEID VARIABLES DETERMINED BY ANALYSIS OF PERIOD RATIOS. Petersen, J. O. (Univ. of Copenhagen). Astron. Astrophys.; 27: No. 1, 89-93(Aug 1973).

For 8 double mode Cepheids with periods of the fundamental mode in the range 1.9 to 3.7 days masses and radii are determined by a comparison of observed ratios of the first over-tone to the fundamental period with period ratios derived by means of the theory of radial oscillations. The derived mass values are in the interval $0.7 \leq M/M_\odot \leq 1.7$. The properties and evolution history of these variables are briefly discussed; perhaps they are intermediate between the Population I RR Lyrae stars and the classical Cepheids. (auth)

13466 PROBLEMS IN THE DETERMINATION OF THE CHEMICAL COMPOSITION OF SUPERGIANTS. Barbaro, G.; Chiosi, C. (Univ., Padua). Astron. Astrophys.; 28: No. 1, 7-14(Oct 1973).

From evolutionary tracks of massive stars in the mass range 10 to 40 $M_\odot$ with different chemical composition, theoretical calibrations of bolometric magnitudes and spectral types of the M. S. turnup and of the n_B/n_R ratio were derived in terms of the age and the initial chemical composition parameters for young clusters. As the use of these calibrations for the simultaneous determination of age and composition for individual clusters seems to be precluded by the large uncertainty affecting experimental n_B/n_R evaluation, an attempt was made to derive how chemical composition changes with galactocentric distance, from a sample of several clusters of the Humphreys catalogue. As the results, leading to an outwards increasing metal content, were in contrast with those obtained from H II regions, it was analyzed how the theoretical background and the uncertainties in the experimental data affect the solution of this problem. (auth)

13467 TRANSITION RADIATION AND T TAURI TYPE STARS. Gurzadyan, G. A. (Astrophysical Observatory, Erevan). Astron. Astrophys.; 28: No. 1, 147-150(Oct 1973).

It is shown that, when fast electrons are present in the dust envelope surrounding a T Tauri type star, transition radiation must arise. The integrated flux of the transition radiation is determined and turns out to be of the order of one per cent of the total radiation of the star. However, the relative importance of transition radiation is quite large in the short wave region of the spectrum— shorter than 3000 Å— and varies within the detectable wavelength range. The short wave transition radiation ($\lambda < 912$ Å) is an additional source of excitation of emission lines in the chromosphere of the star. T Tauri type stars must be sources of cosmic x rays. The expected radiation flux is ~0.01 photon cm^{-2} s^{-1}. (auth)

13468 DEPENDENCE OF THE ENVELOPE STRUCTURE OF HELIUM WHITE DWARFS ON SURFACE GRAVITY AND COMPOSITION. Boehm, K. H.; Grenfell, T. C. (Univ. of Washington, Seattle). Astron. Astrophys.; 28: No. 1, 79-83(Oct 1973).

The influence of relatively small changes of the surface gravity of cool helium white dwarfs ($T_{eff} \approx 6000°K$) on the structure of convective envelope models is unexpectedly large. A change from $T_{eff} = 5500°K$, $g = 5.62 \times 10^7$ cm s^{-2} to $T_{eff} = 5800°K$, $g = 2.63 \times 10^7$ cm s^{-2} leads to a change in the temperature from 2.15×10^5 °K to 1.38×10^6 °K at the bottom of the convection zone where the degeneracy is moderately high ($\alpha \approx -12$) in both cases. Calculations based on nongray model atmospheres lead to lower temperatures at the lower boundary of the convection zone than those based on gray models. A series of envelope integrations for $6250 \lesssim T_{eff} \lesssim 24{,}000$; $g = 1. \times 10^8$ cm s^{-2} were carried out using the chemical composition determined for DF and DG stars by Wegner (1972). The results were compared to those earlier (Böhm and Cassinelli, 1971) for the composition determined by Weidemann (1960). Computations based on Wegner's element abundances lead to lower temperatures at the bottom of the convection zone than those based on the earlier Weidemann abundances. (auth)

13469 DETECTION OF RADIO EMISSION FROM MWC957. Feldman, P. A.; Purton, C. R.; Marsh, K. A. (York Univ., Toronto). Nature (London) Phys. Sci.; 245: No. 142, 39(17 Sep 1973).

MCW957 is an early-type emission line object with an infrared excess, and is a stellar object that has been described as a B_0 star and as a planetary nebula. Radio emission was detected at 2.8 cm. (10.63 GHz) using the 46m. telescope of the Algonquin Radio Observatory, between June 30 and July 5, 1973. The observed mean flux density was 68 ± 10mfu. It was found that the predicted flux density at 2.8 cm was greater than that actually observed by a factor of ~2. Assuming that the bremsstrahlung mechanism is responsible for the infrared emission, it can be concluded that the object is optically thick at 2.8 cm. The maximum flux density is expected to be ~100 mfu at ~30 GHz. (UK)

13470 PION CONDENSATION AND THE MEISSNER EFFECT IN SUPERDENSE NEUTRON STARS. Manassah, J. T. (American Univ. of Beirut, Lebanon). Phys. Lett., 45A: No. 5, 375-376(22 Oct 1973).

The pion condensation in superdense neutron stars is at the origin of a Meissner effect with a very small London penetration depth. (auth)

13471 ELECTRICAL AND THERMAL CONDUCTIVITIES OF STELLAR DEGENERATE MATTER. Kovetz, A. (Tel Aviv Univ., Israel); Shaviv, G. Astron. Astrophys.; 28: No. 2, 315-318(Oct 1973).

A covariant linearized Boltzmann equation, in the relaxation-time approximation, is derived. Its solution is used for calculating the electrical and thermal conductivities of strongly degenerate matter. The results constitute the generalization of Hubbard's (1966) work to the case in which the electron gas is relativistic ($E_F \gtrsim mc^2$). (auth)

13472 1972 SUPERNOVA IN NGC 5253. Photometric Results from the First Observing Season. Ardeberg, A.; de Groot, M. (European Southern Observatory, Santiago de Chile). Astron. Astrophys.; 28: No. 2, 295-304(Oct 1973).

Photoelectric UBV photometry is presented for the bright 1972 supernova in NGC 5253. 48 measurements were made during 16 nights; the period covered was 134 days. The observations provided the normal light and color curves but also made possible a study of minor fluctuations on a minute as well as on a second time scale. Whereas no fluctuations with a time scale less than one hour were found, the presence of a secondary light and color variation with a period between 0.1 and 1.0 days was demonstrated. Comparisons of the measurements with published UBV data showed very good agreement. The distance modulus of the supernova and the absorption affecting the obtained UBV data are discussed. Two photographic prediscovery-magnitude estimates and two upper-limit estimates of the supernova luminosity gave especially high weight to the B light curve. The Zwicky parameters were deduced and are discussed. At the luminosity maximum the apparent blue magnitude was B = 7.75. Accepting the results of van den Bergh and Sérsic for the uncorrected distance modulus this means an absolute blue magnitude of $B_0 = -20.25$. The luminosity maximum in U was found to be 2 to 4 days before and in V 2 to 3 days after that in B. Both the light curves and the color curves were of a type I supernova. The results obtained were compared with those of other supernovae and with theoretical data. Some measures of radiation outburst energy were calculated. The "visual outburst energy" was found to be 7.2×10^{49} erg. Galactic absorption data of Shane and Wirtanen were used. (auth)

13473 EARLY-TYPE METAL-RICH STAR, HD 135485. Dufton, P. L. (Ole Roemer Observatory, Aarhus, Denmark). Astron. Astrophys.; 28: No. 2, 267-277(Oct 1973).

A model atmosphere analysis is presented for the peculiar early-B-type star HD 135485 relative to the normal B 3 V star, χ Cen. Contrary to previous results, the helium enrichment in HD 135485 is found to be small, and probably less than a factor of two. For all other observed elements, logarithmic abundances relative to hydrogen are higher by 0.7 ± 0.3 in HD 135485 than in χ Cen. Hence HD 135485 may be an early-type analogue of the super-metal-rich late-type stars. The position of HD 135485 in the $M_{bol}-T_{eff}$ diagram is within one magnitude of the zero-age hydrogen burning main sequence, suggesting an age of less than 5×10^7 years. As the peculiar composition of HD 135485 probably reflects that of the material from which it was formed, the present interstellar medium would appear to be by no means chemically homogeneous. (auth)

13474 MEASUREMENT OF STELLAR CARBON ABUNDANCES FROM THE CH MOLECULAR SPECTRUM. Hearnshaw, J. B. (Observatoire de Paris, Meudon, France). Astron. Astrophys.; 28: No. 2, 279-288(Oct 1973).

A detailed procedure is described for the accurate measurement of the carbon abundance in cool stars by differential fine analysis of the CH molecular absorption spectrum in the region of 4300 Å. Extensive computational results of the CH spectrum are presented for a grid of line-blanketed model atmospheres, corresponding to dwarfs and subgiants of spectral types about F 6 to K 2. The practical steps to be taken and the problems encountered are discussed. (auth)

13475 NARROW-BAND PHOTOMETRY OF Hα FOR LATE-TYPE STARS. Caplan, J. G. (Laboratoire d'Astronomie Spatiale, Marseille). Astron. Astrophys.; 28: No. 2, 213-215(Oct 1973).

Equivalent widths of Hα are derived from photoelectric photometry with bandpasses of about 5 and 50 Å. The passbands are defined by a pressure-adjustable grating system; centering of the passbands was done for each star, on the basis of geocentric radial velocity. Results for thirty-two stars showed a clear correlation with luminosity (as well as with temperature) and suggested that such observations may provide a practicable luminosity discriminant. (auth)

13476 OBSERVATIONAL STUDY OF THE ATMOSPHERIC STRUCTURES OF M-GIANTS. Huggins, P. J. (Cambridge Univ., Eng.). Astron. Astrophys.; 28: No. 2, 217-225(Oct 1973).

A detailed analysis of lines of Ti I and Fe I in the wavelength region 8350 to 8800 Å was used to investigate the atmospheric structures of cool giant stars. Ten program stars were considered, covering a range in spectral type of K 5 to M 3. The stellar temperatures were deduced from a theoretical calibration of infrared narrow-band indices, and an initial spectroscopic analysis was made on the assumption that all the stars were homologous in temperature–optical depth structure to the K 2 giant α Boo. For the hotter program stars, consistent solutions for the microturbulent velocity parameters of each element were obtained, and surface gravities and metal-to-hydrogen abundances were derived. The latter were found to be approximately solar. For the cooler stars the solutions for the microturbulent velocity parameters were found to be inconsistent and the derived metal abundances were significantly sub-solar. Several mechanisms are suggested to explain this behavior. In particular, an examination of available theoretical model atmospheres, which include molecular opacities, suggests that the solutions for the cooler stars may be rectified by the inclusion of the effects of line-blanketing in the analysis; the demand that the microturbulent velocity parameters derived for each element be consistent, and that the derived metal abundances be temperature independent, indicates rather more differential blanketing between types K 5 and M 3 than is suggested by the simple inclusion of H_2O opacity. The uncertainty in the atmospheric structures of these stars sets wide limits on the accuracy with which their surface-gravities and metal abundances can be determined. (auth)

13477 DERIVATION OF THE LUMINOSITY FUNCTION THROUGH THE METHOD OF TRIGONOMETRIC PARALLAXES. Muzzio, J. C. (Observatorio Astronomico, La Plata). Astron. Astrophys.; 28: No. 2, 227-235(Oct 1973).

The luminosity function for moderately bright and faint stars in the solar neighborhood is derived by the method of trigonometric parallaxes from a sample of large proper motion stars in the Northern Hemisphere. Stars without known trigonometric parallaxes and stars with proper motions smaller than the imposed proper motion limit, μ_0, are accounted for by factors of incompleteness. Corrections for observational errors in the trigonometric parallaxes and in the systems of photographic apparent

magnitudes are applied statistically. The luminosity function, based on stars within 20 pc of the Sun, is shown; systematic errors are shown to be negligible. Comparison with other recent determinations suggests that the luminosity function depends strongly on the volume of space under consideration. (auth)

13478 CARBON ABUNDANCE IN THE ATMOSPHERES OF HYDROGEN-POOR WHITE DWARFS. Bues, I. (Univ., Kiel). Astron. Astrophys.; 28: No. 2, 181-195(Oct 1973).

Helium-rich model atmospheres with various ratios of He:C are computed in the range $12000 \geq T_{eff} \geq 6000$ K, $7 \leq \log g \leq 9$ to account for white dwarfs of spectral types λ 4670, DC, and DF. From a detailed discussion of molecule formation and a comparison of energy distributions with scanner data limits of abundances for the λ 4670 stars are found to be $He:He \leq 10^{-4}$, $1000 > He:C > 100$, $C:O > 12$, C:heavy metals $> 10^5$ whereas DF and DC stars have abundance ratios of $He:C > 1000$, $C:O < 12$. Effective temperatures were derived from Strömgren colors for some DC, DF, and λ 4670 stars. (auth)

13479 BROADENING AND SHIFT OF CALCIUM LINES BY VAN DER WAALS INTERACTION WITH ARGON ATOMS AND BY ELECTRON IMPACT. Huehn, R.; Kusch, H. J. (Univ., Kiel). Astron. Astrophys.; 28: No. 2, 159-164(Oct 1973).

Line broadening and shift of two neutral and two ionic lines of calcium were investigated by means of a gas-stabilized arc running between a carbon cathode and a calcium anode in a high-pressure argon atmosphere. Line broadening parameters for van der Waals interaction and for electron impact were obtained from the total line profiles by a separation method involving the different dependence of the two effects on temperature and on number densities. The results were compared with theoretical values from Lindholm's theory and from electron impact calculations by Griem. (auth)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstracts 13412, 13420–13423, 13449, 13589, 13606, 13643, and 14410.

13480 21-CENTIMETER ABSORPTION AT z=0.692 IN THE QUASAR 3C 286. Brown, R.L.; Roberts, M.S. (National Radio Astronomy Observatory, Charlottesville, Virginia). Astrophys. J. Lett. 184: No. 1, L7-L10 (15 Aug 1973).

The 21-cm hydrogen line has been detected in absorption at 839,407 MHz in the quasar 3C 286; this corresponds to a redshift of $z_{abs}=0.692154$. The narrow velocity dispersion of the line, $\Delta v=8.2$ km s^{-1}, together with the large inferred column density of neutral hydrogen $N_H=2.6\times10^{18}$ T_S cm^{-2}, suggest that the most likely origin of the absorption is an intervening galaxy. With this interpretation we conclude that at least 81.5 percent of the emission-line redshift of 3C 286 ($z_{em}=0.849$) is cosmological. (auth)

13481 HNC MOLECULE IN INTERSTELLAR SPACE? SOME PERTINENT THEORETICAL CALCULATIONS. Pearson, P.K.; Blackman, G.L.; Schaefer, H.F. III (Department of Chemistry, University of California, Berkeley); Roos, B.; Wahlgren, U. Astrophys. J. Lett. 184: No. 1, L19-L22 (15 Aug 1973).

Ab initio calculations have been performed on the HNC molecule to determine molecular properties useful in identifying its rotational spectrum. Both self-consistent-field (SCF) and extensive configuration interaction (CI) methods were used. The SCF treatment yielded $R_{HN}=0.986$ Å, $R_{NC}=1.159$ Å, $B_e=46.3$ GHz, $eqQ(^{14}N)=0.93$ MHz, $\mu=2.91$ D. The CI calculations yielded $R_{HN}=0.995$ Å, $R_{NC}=1.169$ Å, and $B_e=45.43$ GHz. The molecule identified as HNC by Snyder and Buhl as $B_0=45.33$ GHz. (auth)

13482 MWC 349, AN OPTICAL, RADIO, AND INFRARED SOURCE. Greenstein, J.L. (Hale Observatories, California Institute of Technology, Carnegie Institution of Washington). Astrophys. J. Lett. 184: No. 1, L23-L27 (15 Aug 1973).

Optical multichannel photometry is combined with radio infrared data on MWC 349. The optical continuum and line emission varied in 24 hours. A very reddened, probably hot star coexists with a small H II region of high electron density, a dust cloud (radiating above 1 μ), and (probably) an inhomogeneous thermal radio source. A tentative model is described. (auth)

13483 OPTICAL STUDIES OF UHURU SOURCES. VI. THE IDENTIFICATION OF THE OPTICAL COUNTERPART OF 2U 0115-73=SMC X-1. Liller, W. (Harvard College Observatory, Cambridge, Massachusetts). Astrophys. J. Lett. 184: No. 1, L37-L39 (15 Aug 1973).

A study of the stars in and near the error box for XMC X-1=2U 0115-73 has revealed that Sanduleak No. 160, a B0 supergiant located on the southeast edge of the Small Magellanic Cloud, shows small light variations which go through a double cycle with a period equal to that of the X-ray binary. (auth)

13484 SPECTRA OF SOURCES IN THE 5C SURVEY REGIONS. Condon, J.J. (National Radio Astronomy Observatory, Green Bank, West Virginia); Jauncey, D.L. Astrophys. J. Lett. 184: No. 1, L33-L36 (15 Aug 1973).

Statistical investigation of the spectral index distributions of sources found in the 5C surveys reveals significant radially dependent errors in the 5C flux densities at both 408 and 1407 MHz. Previously reported survey-region or flux-density dependences of these spectra do not appear to be real. (auth)

13485 X-RAY SPECTRUM OF CASSIOPEIA A: EVIDENCE FOR IRON LINE EMISSION. Serlemitsos, P.J.; Boldt, E.A.; Holt, S.S.; Ramaty, R. (NASA, Goddard Space Flight Center). Astrophys. J. Lett. 184: No. 1, L1-L5 (15 Aug 1973).

A sensitive measurement by rocket-borne detectors of the X-ray flux from Cas A has revealed a steep continuum and a broad spectral feature in the region where line radiation from iron nuclei would be expected. The flux in this feature is 0.0122 ± 0.0017 photons cm^{-2} s^{-1}. The presence of broad iron lines is consistent with a model in which ~13 MeV-per-nucleon iron nuclei charge exchange with surrounding interstellar oxygen and other heavy atoms. The model suggests that a substantial fraction of the energy from the outburst has gone into low-energy cosmic rays which produce the observed H II region surrounding the remnant. (auth)

13486 RELATIVISTIC ASTROPHYSICS. V. Black Holes As Energy Sources. Lasota, J. P. (Zaklad Astronomii PAN, Warsaw). Postepy Astron.; 21: No. 3, 251-259(Sep 1973). (In Polish).

Physical processes in which black holes may take part are described: collisions, Penrose process and superradiative scattering, floating orbits, and synchrotron radiation. (auth)

13487 GAMMA RAYS: FROM NEUTRON STARS, SUPERNOVAS, OR BEEBEES. Metz, W. D. , Science; 182: No. 4118, 1234-1237(21 Dec 1973).

The gamma-ray bursts first detected by the Vela satellites are discussed and six theories as to their origin are summarized. (WDM)

13488 FABRY–PEROT INTERFEROMETRIC STUDIES ON H II REGIONS. Hippelein, H. H. (Max-Planck-Institut fuer Astronomie, Heidelberg). Astron. Astrophys.; 25: No. 1, 59-62(May 1973).

The radial velocities of several H II regions in Cygnus were measured with a Fabry–Perot interferometer. One of them, S 124, lies in the western prolongation of the Perseus arm. The nebula IC 1318 was studied in detail. Its parts b and c were found to have the same physical properties and thus might be connected with one another. The same holds for the nebulae NGC 7000 and IC 5070. (auth)

13489 NEW REDSHIFT MECHANISM FOR QUASARS. Ross, D. K. (Iowa State Univ., Ames). Astron. Astrophys.; 24: No. 3, 471-474(May 1973).

A new redshift mechanism for quasars is proposed which uses the variation of particle rest masses and hence atomic energy levels in a scalar gravitational field. The scalar field is a modified version of the Brans–Dicke field in which the coupling constant ω is not a universal constant and the only sources of the scalar field in the Universe are the quasars. Since the redshift depends only on the ratio of the scalar field at the quasar to the scalar field at the Earth, this leads to the possibility of large redshifts. The usual Brans–Dicke formalism can produce only relatively small redshifts. (auth)

13490 PULSE PROFILE CHANGES IN PSR 0329 + 54 AT 10.7 GHz. Hesse, K. H.; Sieber, W.; Wielebinski, R. (Max-Planck-Institut fuer Radioastronomie, Bonn). Nature (London) Phys. Sci.; 245: No. 143, 57-58(24 Sep 1973).

New and unusual profile changes shown by PSR 0329 + 54 at 10.7 GHz are reported, further establishing a frequency difference. The observations were made in October 1972 and May 1973 with the 100-m telescope at the Max-Planck Institut, equipped to receive linearly polarized radiation, and details are given of the experimental technique. It was confirmed that the profile changes are a recurring feature. During a sequence of observations, each consisting of an integration of 3,000 pulses followed by transfer to magnetic tape, in which only the main component could be seen clearly, a second component suddenly became visible; this was so strong that after 1,000 pulses it was larger than the main component. The new component disappeared as suddenly as it had appeared; its duration was ~50 min., and it represented a real pulse profile change and not a polarization effect. The enhanced emission at 10.7 GHz could be interpreted in terms of a channelling of more particles into a location, or of greater coherence of particles already present; the lifetime could then

be interpreted as the duration of enhanced particle emission from the pulsar's surface, or as the duration of enhanced coherence in the magnetosphere. (UK)

13491 DISTANCE DETERMINATION OF VARIABLE X-RAY SOURCES. Truemper, J. (Univ., Tuebingen, Ger.); Schoenfelder, V. Astron. Astrophys.; 25: No. 3, 445-450(Jun 1973).

A new method is described for the direct determination of the geometric distance of x-ray sources. The method is applicable to variable x-ray sources and implies the existence of an x-ray halo, which is formed by scattering on interstellar dust. Time structures are delayed and smeared out in the halo. Since the time scales involved depend linearly on the source distance the latter can be determined by measuring damping effects across the halo. Also, information can be obtained about the dust density distribution along the line of sight. (auth)

13492 GIANT LOOPS AS FOSSIL STROEMGREN SPHERES: THEIR RADIO AND X-RAY EMISSION. Kafatos, M. C. (Univ. of Colorado, Boulder); Morrison, P. Astron. Astrophys.; 26: No. 1, 71-77(Jul 1973).

The loops are examined as radio and soft x-ray sources under the assumption that they are objects related to the Gum Nebula but much older than it. The loop diameters are likely on the scale of 100 pc or more, as reported recently. This is naturally understood with the fossil Strömgren sphere model. Further progress in understanding the origin of the loops depends on the resolution of certain observational issues. (auth)

13493 BEAMING OF RADIATION FROM AN ACCRETING MAGNETIC NEUTRON STAR AND THE X-RAY PULSARS. Gnedin, Yu. N. (Ioffe Inst. of Physics and Tech., Leningrad); Sunyaev, R. A. Astron. Astrophys.; 25: No. 2, 233-239(Jun 1973).

As a result of accretion, a neutron star with a strong magnetic field $H \sim 10^{10}$ to 10^{12} Gauss may exhibit characteristics of an x-ray pulsar with a knife radiation pattern. The infalling gas is channeled to the magnetic pole regions where its kinetic energy is released as it strikes the star surface. The cyclotron radiation at high gyrofrequency harmonics (lying in the x-ray range) determines the rate of energy removal from the hot plasma ($kT_e \sim$ 10 to 100 keV). The net harmonic radiation spectrum resembles the spectrum of bremsstrahlung radiation from an optically thin plasma, but with a lower temperature. Radiation at high harmonics is characterized by a strong beaming perpendicular to the magnetic field lines of force. However the situation is also possible, when the radiating electrons are relativistic and move at small pitch angles to the magnetic field. In this case the Doppler-shifted cyclotron radiation at $\nu \gg \nu_H$ is directed along magnetic field, forming the pencil diagram. (auth)

13494 FARADAY DEPOLARIZATION OF RADIO GALAXIES AND QUASARS WITH SIMPLE SPECTRA. Strom, R. G. (Sterrewacht, Leiden). Astron. Astrophys.; 25: No. 2, 303-312(Jun 1973).

Measurements are presented of the linear polarization of a number of radio galaxies at a wavelength of 49 cm; these along with previous measurements made at 49 and 73 cm have been used individually, and in combination with observations made at shorter wavelengths, to investigate Faraday depolarization. Evidence is given that for sources with simple radio spectra, depolarization increases with decreasing component separation. It is shown that this is consistent with Faraday dispersion due to the presence of thermal material within radio source components. The effects of galactic depolarization source luminosity and brightness are also discussed and found to be relatively insignificant. (auth)

13495 MINIMUM KINEMATIC DISTANCE ESTIMATE TO THE NONTHERMAL SOURCE IN W51 BASED ON OH ABSORPTION LINE MEASUREMENTS. Wilson, T. L. (Max-Planck-Institut fuer Radioastronomie, Bonn). Astron. Astrophys.; 25: No. 2, 329-331(Jun 1973).

1667 MHz OH observations of the nonthermal shell source in W51 (at $l = 49.2°$, $b = 0.7°$ and $l = 49.0°$, $b = -0.5°$) show absorption extending to 58.6 km/s. Use of the Schmidt (1965) velocity-distance relation indicates that the kinematic distance to this source is at least 5.4 kpc. (auth)

13496 OBSERVATIONS OF NEW GALACTIC H II REGIONS AND EXCITING STARS. Georgelin, Y. M.; Georgelin, Y. P.; Roux, S. (Observatoire, Marseille). Astron. Astrophys.; 25: No. 3, 337-350(Jun 1973). (In French).

UBV photometry and spectral types are presented for 45 exciting stars together with radial velocities of 60 new H II regions obtained with Fabry-Perot rings. The interferometric observations were made at the 120 cm telescope of the Haute Provence Observatory. Spectral classification was made on spectra with a dispersion of 39 Å mm^{-1} obtained with the coudé spectrograph of the 193 cm telescope. UBV observations were made at the 60 cm telescope. (WDM)

13497 HIGH RESOLUTION 21 CM CONTINUUM STUDY OF THE SUPERNOVA REMNANTS 3C 10 (TYCHO'S SUPERNOVA REMNANT) AND 3C 461 (CAS A). Strom, R. G.; Duin, R. M. (Sterrewacht, Leiden). Astron. Astrophys.; 25: No. 3, 251-362 (Jun 1973).

Synthesis observations made with the Westerbork telescope were used to produce maps of the supernova remnants 3 C 10 and 3 C 461. The Stokes parameters I, Q, and U were determined with a resolution of about 25″. The total intensity map of 3 C 10 showed significant emission from the remnant's center, and the results can be approximately reproduced by a spherical shell of synchrotron emitting material. The best shell model, whose thickness is one-fourth of its outer radius, also requires that the magnetic fields have an ordered component predominantly in the radial direction. Such a configuration, which has been previously suggested for 3 C 461, is in accord with high frequency polarization measurements. The degree of linear polarization from 3 C 461 was generally under 1%. The polarization of Tycho's remnant is dominated by a cellular structure wherein the position angle remains constant within regions of about 1′ diameter, while large changes can occur between adjacent regions. The degree of polarization within cells, running as high as 14%, was virtually the same as that obtained at higher frequencies. The interpretation most consistent with the data is that differential Faraday rotation occurs in a thin screen surrounding the remnant, and this is identified with magneto-ionic material swept up from the interstellar medium. Thus the shell of relativistic particles is surrounded by a thin, relatively dense screen of hot gas which produces the differential rotation, the weak optical emission, and, presumably, the soft x-ray emission. (auth)

13498 HIGH-SENSITIVITY SEARCH FOR RADIO EMISSION FROM YOUNG EXTRAGALACTIC SUPERNOVA REMNANTS AT 1415 MHz. de Bruyn, A. G. (Sterrewacht, Leiden). Astron. Astrophys.; 26: No. 1, 105-112(Jul 1973).

A search for radio emission from the remnants of about 35 extragalactic supernovae was made with the Westerbork Synthesis Radio Telescope. None of the remnants, which had ages from 1 month to 86 years, was detected. Typical upper limits for their flux density at 1415 MHz were 2 to 5×10^{-29} W m^{-2} Hz^{-1}. The results were compared with the empirically determined radio evolution of (much older) galactic supernova remnants (SNR). It appeared that they mostly fall significantly below an extrapolation of this relation to small radii. A consideration of possible absorption effects indicated that free–free absorption in the ionized supernova envelope could be important in explaining the negative results as could a deficiency of low-energy electrons ($\lesssim$ 500 MeV). The detection of some radio sources which could be SNR older than about 50 years could be evidence that one or both effects is actually present for the 25 to 50 year old SNR. The results were also compared with current theories about the evolution of young galactic SNR. The negative results were consistent with a model recently put forward by Gull (1973); his model predicts little radio emission in the first 100 years or so. A comparison with models in which both the magnetic field and the relativistic electrons in a SNR device from a rotating neutron star indicated that for such models the injection rate of "radio" electrons (0.1 to 10 GeV) in the first 50 years can at most be of the same orders as in the next few hundred years. (auth)

13499 NATURE OF X-RAY BINARIES. III. Evolution of Massive Close Binaries with One Collapsed Component: A Possible Application to Cygnus X-3. van den Heuvel, E. P. J. (Astronomical Inst., Utrecht); De Loore, C. Astron. Astrophys.; 25: No. 3, 387-395(Jun 1973).

The evolution is computed for close binaries consisting of a massive primary (15 $M_\odot$ or 21 $M_\odot$) together with a neutron star secondary ($M_\odot$ or 2 $M_\odot$) with orbital periods between 2 and 6 days. Two cases are considered, viz. (i) the neutron star is able to accrete the 10^{-3} $M_\odot$/yr lost by the primary after this star has started to overflow its Roche lobe, and (ii) accretion onto the neutron star is limited to $\lesssim 10^{-7}$ $M_\odot$/yr, due to the critical luminosity; in case (ii) practically all mass lost from the primary is lost from the system or is dispersed around the system. In all cases it is found that before the system stabilizes the primary loses most of its hydrogen-rich outer layers and becomes a hot luminous star, mainly consisting of helium. In case (i) the secondary becomes a massive black hole and the final binary period is of the order of a few hours. Also in case (ii) the binary period decreases drastically even if the escaping matter carries with it a minor fraction (<10%) of the dynamical energy of the system. It is suggested that the final systems may be identified with x-ray sources such as Cygnus X-3 (P_x = 4.8). In case of a

black hole (instead of a neutron star) secondary the evolution of the system is expected to follow a similar pattern. (auth)

13500 PHASE VELOCITY EFFECTS IN NONLINEAR COMPTON SCATTERING. Stewart, P. (Univ. of Manchester, Eng.). Astron. Astrophys.; 25: No. 3, 457-460(Jun 1973).

An intense circularly polarized electromagnetic wave whose phase velocity is greater than $c = 3 \times 10^{10}$ cm/s can cause a charged particle to radiate energy at a much greater rate than if the phase velocity is equal to c. The power radiated can in certain cases depend on the fourth power of electric field. (auth)

13501 OBSERVATIONS OF THE LINEAR POLARIZATION OF RADIO SOURCES AT 2.8 AND 4.5 CM. Bignell, R.C.; Seaquist, E.R. (David Dunlap Observatory, University of Toronto, Richmond Hill, Ontario, Canada). Astron. J. 78: No. 7, 536-556 (Sept 1973).

We present in this paper the results of a survey of the linear polarization at 2.8 and 4.5 cm of 22 QSR's, 10 galaxies, 11 unidentified sources and one supernova remnant. The observations were made with the Algonquin Radio Observatory 46-m telescope during the period May 1968–November 1970. Of the 25 variable flux density sources observed, seven exhibited statistically significant temporal variations in polarization, while 16 were marginally significant and two showed no variations. The polarization of the source PKS 2134 + 004 was found to vary at both 2.8 and 4.5 cm even though its flux density did not undergo temporal changes. (auth)

13502 TIME VARIATIONS OF THE LINEAR POLARIZATION OF EXTRAGALACTIC RADIO SOURCES AT 2.8 CM AND 4.5 CM. Bignell, R.C. (David Dunlap Observatory, Richmond Hill, Ontario). Astron. J. 78: No. 7, 557-564 (Sept 1973).

The variations of polarization at wavelengths of 2.8 and 4.5 cm of extragalactic radio sources are compared with the adiabatically expanding model. For a few sources the variations are consistent with this model, occurring first at the shorter wavelength. However more than 60% of the variable sources show changes in position angles that are larger at the longer wavelength. In particular, it is found that for 3C279 the variations of position angles with the square of the wavelength defined at wavelengths of 2.8, 3.75, and 4.5 cm is linear at all times, and that the overall change in position angle is larger at the longer wavelengths. These observations are consistent with a variation in the amount of Faraday rotation in 3C 279. It is concluded that the variations in polarization are probably produced by a combination of variations in Faraday rotation and in optical depth due to synchrotron self-absorption. The variations of polarization are used to estimate the degree of polarization of the variable components; the synchrotron self-absorption assumption was introduced in order to calcualte the magnetic-field strengths, and upper limits to the densities of ionized gas are then calculated. The densities within the variable components are generally found to be less than 10^4 cm^{-3}. Furthermore, the densities of ionized gas within all but a few variable sources are found to be too small for the Razin–Tsytovich effect to be operating within the observable wavelength range. (auth)

13503 INTERFEROMETRIC MEASUREMENTS OF THE COMPACT SOURCE 2048 + 31. Becker, R. H.; Kundu, M. R. (Univ. of Maryland, College Park). Nature (London) Phys. Sci.; 244: No. 139, 138-139(27 Aug 1973).

It is stated that observations made at 6 cm, with a 6 arc min. pencil beam, and other observations at 11 and 3 cm with 4.8 and 1.2 arc min. pencil beams, revealed a compact radio source several arc min. north of the Cygnus Loop. The 3 cm observations failed to resolve the source, implying an angular size < 1 arc min. The source was designated 2048 + 31. Using the three element interferometer of the National Radio Astronomy Observatory, operating at 3.7 and 11.1 cm., observations were made with a view to determining the structure and spectrum of the source. The source was unresolved at 3.7 cm even with the longest baseline, placing an upper limit of 1 arc s. on its size. There was some indication that the source is variable at 3.7 cm. No significant linear polarization was observed. Data are given on the position of the source as determined from interferometric data; this agrees well with the position determined at 6 cm from observations made with the Westerbrook Synthesis Radio Telescope, and is in excellent agreement with the location of a stellar object on the blue Palomar Sky Survey print. It appeared that the source may be physically associated with the Cygnus Loop, but on the other hand it shows several characteristics of an extragalactic source, notably size, variability, and association with a stellar object. (UK)

13504 P–N JUNCTIONS IN PULSAR MAGNETOSPHERES. Holloway, N. J. (Cambridge Univ., Eng.). Nature (London) Phys. Sci.; 246: No. 149, 6-9(5 Nov 1973).

It is stated that the conventional model of the magnetosphere of axisymmetric pulsars contains a boundary between regions of negative and positive space charge, and this boundary may be capable of sustaining a finite potential difference, as well as allowing the existence of metastable magnetosphere states in which there are evacuated regions and regions that rotate more rapidly than the central object. The property of the zero charge boundary in that it can sustain a potential difference in one direction only, has led to the description "p-n junction", by analogy with the semiducting diode rectifier. Associated effects are discussed. (UK)

13505 OBSERVATIONS OF CYG X-1 AND CYG X-3 ABOVE 7 keV FROM OSO-7. Baity, W. A.; Ulmer, M. P.; Wheaton, W. A.; Peterson, L. E. (Univ. of California, San Diego, La Jolla). Nature (London) Phys. Sci.; 245: No. 145, 90-92(8 Oct 1973).

Cygnus X-1 and X-3 were scanned in the 7-to 250-keV range during December 1971, using a NaI(Tl) scintillation detector on the UCSD cosmic x-ray telescope carried by the OSO-7 satellite. Reasons why the observations are of interest are given. Spectra are shown that, when combined with other observations, may indicate long term changes in the sources. Counting rates from Cyg X-1 in the 7 to 22 and 22 to 37 keV energy ranges are shown graphically. The most significant feature is the absence of an intensity decrease in the Cyg X-1 flux predicted by an eclipsing binary model based on studies of the probable optical counterpart, the BO star HDE 226868. This lack of eclipse is incompatible with the synchrotron emission model, which predicts an eclipse above 20 keV. An investigation was also made of the reported factor-of-two changes of x-ray intensity in Cyg X-3, with a period of 0.199667 ± 0.000014 days; results were inconclusive. The spectra of Cyg X-1 and X-3 are shown, averaged over the seven days observation period and it was concluded that a simple power law or a blackbody spectrum is unacceptable. Spectral shapes seem to be the only similarity between Cyg X-1 and Cyg X-3 spectra. The latter shows 4.8 hr periodic x-ray variations and is a strong and highly variable radio source with no visible counterpart, whereas Cyg X-1 apparently shows no periodic hard x-ray variations, is a weak radio source, and has a well studied binary counterpart, with an irregularly pulsating component that has been suggested to be a black hole. (UK)

13506 PECULIAR OBJECT NEAR X2 + 5. Glass, I. S.; Feast, M. W. (Royal Observatory, Cape Town). Nature (London) Phys. Sci.; 245: No. 142, 39-40(17 Sep 1973).

It was known that the x-ray source GX2 + 5 lies in a region of heavy obscuration. In a scan made in May 1973, using an infrared photometer attached to the 74 inch Radcliffe reflector, a bright object was found close to the center of the GX2 + 5 error box having infrared magnitudes 10.39 ± 0.08 (1.25 μm), 8.85 ± 0.10 (1.65 μm), and 8.10 ± 0.05 (2.2 μm). Its spectra were determined using a Carnegie image tube attached to the Cassegrain grating spectrograph on the reflector. It showed strong Hα emission and also weak Hβ and OIII 5007 emission. The Hα/Hβ intensity ratio was 55; such a steep gradient indicating heavy obscuration. The reddening colors indicated a late-type star. The visual brightness comes almost entirely from Hα emission, and the high absorption probably indicates a very distant object. If it is in the vicinity of the galactic center the visual absolute magnitude of the stellar component would be –5 mag. The nature of the object is not entirely clear — it may be related to the symbiotic class, but it should be considered as a candidate for identification with GX2 + 5. (UK)

13507 HARD X RAYS FROM THE REGION OF AQUILA XR-1. Kunte, P. K.; Durgaprasad, N.; Gokhale, G. S.; Iyengar, V. S.; Manchanda, R. K.; Streekantan, B. V. (Tata Inst. of Fundamental Research, Bombay). Nature (London) Phys. Sci.; 245: No. 142, 37-38(17 Sep 1973).

What is believed to be the first evidence for hard x-ray emission from Aql XR-1, or the region close to it, is here reported, together with spectral results in the energy range 14 to 50 keV. The observations were made with a balloon-borne telescope flow from Hyderabad on March 9, 1973, to a ceiling altitude of 4 g/cm^2. (UK)

13508 MODEL FOR THE SECOND OUTBURST OF CYG X-3. Icke, V. (Sussex Univ., Brighton, Eng.). Nature (London) Phys. Sci.; 244: No. 139, 132-133(27 Aug 1973).

It is stated that detailed monitoring of the activity of Cyg X-3 at 1.4 and 2.7 GHz showed that the outburst in September 1972 consisted of two parts: a single event with maximum on September 4th, and a triple event with maxima on September 21, 24, and 26. It seemed that the first outburst could be described by an adiabatically expanding synchrotron source, and it is proposed that the second outburst was essentially similar to the first, its complicated structure being due to interaction of the second shock front with the debris of the first. The fact that there were three peaks in the second event was due to the structure of the source. Analogies between the behavior of Cyg X-3 and Sco X-1 suggested that the Cygnus source may also be a double. A model is presented

for the behavior, and a more detailed model, involving more precise calculations on the merging of the shocks and on the emission spectrum, is being constructed. (UK)

13509 RADIO STARS AND X-RAY SOURCES. Bahcall, J. N.; Kellogg, E. M. (Inst. for Advanced Study, Princeton, NJ). Nature (London) Phys. Sci.; 244: No. 139, 135-136(27 Aug 1973).

Limits are reported on x-ray emission from known radio stars. The results are of interest because of the possible association between x-ray binaries and radio star binaries, and because measurements of x-ray fluxes can help determine the source of the radio emission. The principal results are shown tabulated, and were obtained from Uhuru data. None of the radio stars was detected as an x-ray source. A typical upper limit to the x-ray flux (2 to 6 keV) from one of the radio stars is 3×10^{-11}erg/cm^2/sec., which is about 3×10^{-3}mfu, or 0.3% of the average x-ray flux from Cyg X-1. The seven radio stars for which results are given show comparable radio fluxes (1 to 10 mfu) but except for HDE226868 none are strong x-ray sources. This suggests that there are two types of radio binary stars, one which is a strong x-ray source and the other not. Radio stars that are also strong x-ray emitters may contain an additional component in the binary system, for example, a black hole or a large magnetic field, or they may simply be hotter versions of the same basic system. Mechanisms are discussed. (UK)

13510 X-RAY ABSORPTION AND OPTICAL EXTINCTION IN INTERSTELLAR SPACE. Reina, C. (Univ., Milan); Tarenghi, M. Astron. Astrophys.; 26: No. 2, 257-261(Jul 1973).

X-ray and optical observations of five identified galactic x-ray sources provide an empirical relation between x-ray absorption and optical extinction in interstellar space. The density ratio of gas to dust in the line of sight of these sources is evaluated. Attributing the low-energy cutoffs observed in the spectra of several galactic x-ray sources to interstellar absorption, the reddening of their optical counterparts is estimated. (auth)

13511 OBSERVATIONS OF GALACTIC SUPERNOVA REMNANTS AT 1.7 AND 2.7 GHz. Willis, A. G. (Univ. of Illinois, Chicago). Astron. Astrophys.; 26: No. 2, 237-255(Jul 1973).

Maps of fifteen galactic supernova remnants with angular resolution ~5′ at a frequency of 2.7 GHz are presented, and 1.7 GHz flux densities of several of the sources are given. Several of the remnants are examined in detail to determine associations between radio and optical features, spectral index variations, and the distribution of radio emissivity giving rise to the observed source structure. Analysis of a large number of remnants showing shell structure indicates that the ratio of shell thickness to source radius of supernova remnants does not evolve in any particular way as a function of surface brightness (Σ). Using the assumption of equipartition it is shown that the magnetic field strength is proportional to $\Sigma_{1000MHz}^{0.17}$. Point sources within the supernova remnant maps are found to be random extragalactic background sources and not knots of high surface brightness associated with the supernova remnants. (auth)

13512 STATISTICAL ACCELERATION OF ULTRARELATIVISTIC ELECTRONS BY RANDOM ELECTROMAGNETIC WAVES. Blandford, R. D. (Inst. of Astronomy, Cambridge, Eng.). Astron. Astrophys.; 26: No. 2, 161-170(Jul 1973).

A classical treatment of induced Compton radiation is presented. This treatment is then generalized to the relativistic case and the behavior of the electron distribution functions in stationary radiation fields is investigated. The astrophysical application of these results is discussed. (auth)

13513 H_2O SOURCES IN SHARPLESS H II REGIONS. Lo, K. Y.; Burke, B. F. (Massachusetts Inst. of Tech., Cambridge). Astron. Astrophys.; 26: No. 3, 487-488(Aug 1973).

H_2O microwave emission has been detected in 2 Sharpless regions. Both have related OH emission, radio condensations, and one has related infrared emission also. (auth)

13514 18-CM OH ABSORPTION OF W 49 A and W 49 B. Pastchenko, M. I. (State Astronomical Inst., Moscow); Slysh, V. I. Astron. Astrophys.; 26: No. 3, 349-351(Aug 1973).

A similar 18-cm OH absorption was found in both components of the radio source W 49. Two absorption features at the velocities of +60 and +40 km/s are attributed to the Sagittarius arm while the third absorption feature at about +15 km/s was found to be local to the source, suggesting the existence of a molecular cloud around the thermal component W 49 A. The nonthermal source W 49 B is located at the edge of the cloud about 100 pc away from W 49 A. The molecular cloud is identified with a hydrogen cloud in 21-cm studies and has the usual abundances of OH and H_2CO molecules. (auth)

13515 SECOND-ORDER PLASMA INTERACTION IN THE CRAB NEBULA. Pal, J.; Srivastava, K. M. (Univ. of Jodhpur, India). Astron. Astrophys.; 26: No. 3, 379-383(Aug 1973).

It is shown that the second-order interaction with the relativistic plasma leads to an amplification of the Alfvén waves when the mean velocity of relativistic plasma relative to the thermal plasma exceeds the Alfvén speed. It is found that the second-order interaction stabilizes the relativistic plasma. The (k,σ) relation is shown in graphical form for the Maxwell–Boltzmann and a cosmic-ray distribution function. (auth)

13516 SYNTHESIS RADIO TELESCOPE AT WESTERBORK. Methods of Polarization Measurement. Weiler, K. W. (Univ., Groningen, Netherlands). Astron. Astrophys.; 26: No. 3, 403-407(Aug 1973).

From the formula for the generalized response of a correlation interferometer to an incident partially polarized radio wave, the forms for the four output channels from each interferometer in the Westerbork telescope are developed. Then, the means of instrument gain, phase, and polarization calibration are detailed and the solutions for the four Stokes parameters obtained. The advantages and disadvantages of the technique are briefly discussed. The Appendix contains a derivation of the basic initial formula. (auth)

13517 INFRARED EMISSION OF H II REGIONS DUE TO DUST. Andriesse, C. D.; Olthof, H. (Univ. Groningen, Netherlands). Astron. Astrophys.; 27: No. 2, 319-321(Sep 1973).

A physical model is discussed for the conversion of ultraviolet to infrared radiation in a cloud of dust particles. When the density is low, the cloud is expected to radiate according to a blackbody spectrum, diluted for frequencies below 10^{13} s^{-1}. Using a simple dilution factor, data were analyzed for the Kleinmann–Low extended infrared source in the Orion Nebula. The rapid increase of emission around 10^{12} s^{-1} is explained when the particle temperature is 70 K and the total mass is 0.03 $M_\odot$. This compares with a kinetic temperature of molecules in this source of 40 K and with an H II mass of 13 $M_\odot$. (auth)

13518 SELF-CONSISTENT MODELS FOR THE PULSAR MAGNETOSPHERE. Salvati, M. (Laboratorio di Astrofisica Spaziale, Frascati, Italy). Astron. Astrophys.; 27: No. 3, 413-415 (Sep 1973).

The Goldreich–Julian model for the pulsar magnetosphere was investigated, specifically the properties connected with the critical line; for this purpose a systematic use of the condition that the particle velocity must not exceed the light velocity, and of the asymptotic form of the basic equation governing the model, is resorted to. It is shown that either the wind pattern is disconnected, i.e. the lines emerging from the star do not fill the whole space, or the charge separation cannot be complete. The actual behavior of the separation parameter is also derived. (auth)

13519 IDENTIFICATION OF THE RADIOSOURCE G 355.3 + 0.1 WITH NGC 6383. Crovisier, J.; Fillit, R.; Kazes, I. (Observatoire de Meudon, France). Astron. Astrophys.; 27: No. 3, 417-420(Sep 1973).

Continuum and spectral line observations suggest that G 355.3 + 0.1 has no apparent optical counterpart and that it is an H II region at a distance of about 10 kpc or more. (auth)

13520 PULSE PROFILE VARIATIONS IN PSR 0329 + 54 AT 2695 MHz. Hesse, K. H. (Max-Planck-Institut fuer Radioastronomie, Bonn). Astron. Astrophys.; 27: No. 3, 373-377(Sep 1973).

Observations of pulse profiles for PSR 0329 + 54 at 2695 MHz reveal: (i) an additional component not seen at lower frequencies, (ii) profile variations not identical to those observed at 408 MHz, and (iii) similarities to profile variations of PSR 1237 + 25. (auth)

13521 1633 + 38: A RADIO SOURCE WITH A STRONG, COMPACT COMPONENT. Pauliny-Toth, I. I. K. (Max-Planck-Institut fuer Radioastronomie, Bonn); Preuss, E.; Witzel, A.; Kellermann, K. I.; Fomalont, E. B.; Davis, M. M. Astron. Astrophys.; 27: No. 3, 475-477(Sep 1973).

The radio source 1633 + 38 (4 C 38.41) has a compact component which is opaque at frequencies up to 10 GHz. The unusual nature of the spectrum was first noticed when the source was found to have a surprisingly high flux density in the course of the NRAO 5 GHz sky survey. 1633 + 38 is variable and is identified with a 17th magnitude blue stellar object. (auth)

13522 APERTURE SYNTHESIS OBSERVATIONS OF H II REGIONS. I. A Group of H II Regions Around l = 111. Israel, F. P.; Habing, H. J.; de Jong, T. (Leiden Observatory). Astron. Astrophys.; 27: No. 1, 143-160(Aug 1974).

Aperture synthesis observations at 21 cm are presented of a group of H II regions situated in a 2° × 2° area around l = 111° in the Perseus Arm. The beamwidth used was 24″ × 28″. The group contains the well known objects NGC 7538, the Bubble

Nebula NGC 7635, and S 157. Radial velocity data suggest that all regions are close together. All regions of the group seem to be younger than 10^6 yr, but their apparent ages vary considerably. In general a very good correlation is found between optical and radio features. Three small H II regions of size ≈0.5 pc appear to have emission measures in excess of 10^5 cm^{-6} pc; in this they resemble the Orion nebula. Two regions are of larger size (3 and 7 pc). In addition two optically invisible, point-like sources, that are obscured by local dark matter, are found. Very likely both sources are cocoon stars similar to W 3 OH. The total group of H II regions may be a loose OB association in statu nascendi. (auth)

13523 MEASUREMENT OF NEUTRAL-HYDROGEN ABSORPTION IN THE SPECTRA OF EIGHT PULSARS. Gordon, K. J.; Gordon, C. P. (Hampshire Coll., Amherst, MA). Astron. Astrophys.; 27: No. 1, 119-124(Aug 1974).

Absorption found in the spectra of the pulsars PSR 0329 + 54, PSR 0736 − 40, PSR 1933 + 16, PSR 2016 + 28, and PSR 2021 + 51 yields distance limits of 1.3 < d < 2.0 kpc for PSR 0329 + 54, d > 6 kpc for PSR 1933 + 16, d < 800 pc for PSR 2016 + 28, and tentatively d < 1 kpc for PSR 2021 + 51. Upper limits of $\tau < 0.4$, 0.6, and 0.6 (2σ basis) are placed on the absorption toward PSR 0450 − 18, PSR 0740 − 28, and PSR 1642 − 03, respectively. Properties of the interstellar medium and distance estimates based on 21-cm absorption measurements are summarized for all available pulsar data. The variation of the ratio $\langle n_e \rangle / \langle n_H / T_s \rangle$ among the lines of sight to the several pulsars supports theories of the interstellar gas with temperature and/or density inhomogeneities. A value for the mean electron concentration $\langle n_e \rangle \approx 0.04$ cm^{-3} in the interstellar medium is found. (auth)

13524 INTERACTIVE PROCESSING OF MAP DATA PRODUCED BY THE WESTERBORK SUPERSYNTHESIS RADIO TELESCOPE. Ekers, R. D.; Allen, R. J.; Luyten, J. R. (Univ., Groningen, Netherlands). Astron. Astrophys.; 27: No. 1, 77-83(Aug 1973).

The problems arising in extracting the interesting information from the large amounts of map data which are presently being produced by modern supersynthesis radio telescopes are discussed. Examples are taken from observations made with the Westerbork array. The necessity for visual presentation of the maps and the advantages of certain different types of presentation are discussed. A description is given of an interactive data processing system which has been constructed in a medium-sized computer in order to explore and develop methods for processing radio map data. Various modular program units can be summoned by the user and the results of major steps in the reduction can be presented on an oscilloscope display for rapid visual examination. Based on his evaluation of these results the astronomer can directly alter his choice of the processing sequences to follow. (auth)

13525 BOLOGNA 408 MHz PULSAR SEARCH. Bonsignori-Facondi, S. R.; Salter, C. J.; Sutton, J. M. (Univ., Bologna). Astron. Astrophys.; 27: No. 1, 67-71(Aug 1973).

Pulsar searches made at 408 MHz with the east−west arm of the Bologna Cross telescope are fully described and their sensitivity considered. Details are given of five pulsars found during the searches. (auth)

13526 PULSAR SLOWDOWN. I. Inside Rotating Neutron Stars. Heintzmann, H. (Univ., Cologne); Kundt, W.; Schruefer, E. Astron. Astrophys.; 27: No. 1, 45-50(Aug 1973).

The reaction of rotating neutron stars to externally applied torques is investigated. Both magnetized and nonmagnetized neutron stars are considered. For the canonical pulsar model, toroidal magnetic fields B_φ of order $B_\varphi/B = 3 \cdot 10^{-6}\, B_{12}^{-2}\, \Omega_{-4.5}$ are implied, which act as a torsion spring with oscillation period of order minute ($2\pi/\omega = B_{12}^{-1} \cdot \rho_{c,14}^{3}$ min), and damping time presumably between days and years. Differential rotation of the charged component is smaller than $10^{-6}\, T_8^2$ in the nonmagnetized case, and even much smaller in the magnetized one. (auth)

13527 H I CLOUD IN THE QUASI-STELLAR OBJECT PHL 957. Grewing, M. (Univ., Bonn); Strittmatter, P. A. Astron. Astrophys.; 28: No. 1, 39-46(Oct 1973).

The well established absorption system A ($z_A = 2.309$) in quasar PHL 957 is examined in detail and shown to be consistent with that expected from a pure H I cloud. As such it appears, among all QSO absorption systems observed so far, the most likely to have arisen in an intervening spiral galaxy. The possible presence of lines arising from excited fine structure levels of the ground state is noted and, if confirmed, would argue for an intrinsic origin of the absorption. The metal to hydrogen abundance ratio is discussed and a test of the radiation pressure driven mass loss hypothesis for intrinsic absorption systems is suggested. The results both depend on the degree of saturation in the observed metal lines but could be settled with a comparatively modest increase in resolution. A possible method of sampling the far infrared spectrum of QSO's using the observed uv transitions is indicated. (auth)

13528 MAGNETIC ACCRETION AND A MODEL FOR THE X-RAY BINARY HZ Her. Henriksen, R. N.; Reinhardt, M.; Aschenbach, B. (Univ., Tuebingen, Ger.). Astron. Astrophys.; 28: No. 1, 47-61(Oct 1973).

Mass accretion by rotating objects endowed with magnetic fields is considered. The theory is applied to the case of Her X-1. A model for the 36 day-cycle of Her X-1 is presented. After discussing the models proposed so far, an explanation is offered which seems to cover all confirmed observational facts, in terms of an activity center on the noncorotating surface of the optical companion. This "spot" supplies the material which produces the x-ray pulses via accretion onto the dense object. The optical variability of HZ Her is discussed. There must be an x-ray source in the system which does not exhibit the 36 day cycle and emits much more power than is observed in the Uhuru band. The theory of magnetic monopole accretion by Chia and Henriksen (1972) is further developed. This generalization probably applies to a wide class of magnetic accretion problems. The occurrence of shock waves in the process of accretion is discussed. The theory is applied to the case of Her X-1. Some aspects of the active spot on the optical companion and the differential rotation of its surface layers are treated. The characteristics of the accretion flow are derived. The resulting spectrum is discussed in some detail. This yields a satisfactory explanation of the observed features of the x-ray source, and is in fair agreement with the model proposed. (auth)

13529 SCAN OF THE CYGNUS REGION IN THE 1 TO 10-MeV γ-RAY ENERGY RANGE. Dean, A. (CNR, Milan); De Martinis, C.; Monastero, G. F.; Russo, A.; Scarsi, L. Astron. Astrophys.; 28: No. 1, 131-135(Oct 1973).

The Cygnus region was scanned by a balloon borne γ-ray telescope on the night of July 23-24, 1971. An excess of counting rate over the background level in the (0.8 to 10) MeV γ-ray energy channel was measured coincident with the transit of Cygnus X-2/X-4 through the aperture of the instrument. The γ-ray flux values are given, should this increase in counting rate be due to extraterrestrial emission. (auth)

13530 EXTENDED OH EMISSION AT 1720 MHz. Goss, W. M. (Kapteyn Astronomical Inst., Groningen, Netherlands); Johansson, L. E. B.; Ellder, J.; Hoeglund, B.; Nguyen-Q-Rieu; Winnberg, A. Astron. Astrophys.; 28: No. 1, 89-94(Oct 1973).

Low velocity OH emission lines at 1720 MHz were investigated in the direction of W41, W43, W51, and 3C 353. The emission lines in the direction of W43 and W51 showed no detectable circular polarization and were about 27 and 32 arc min in size, respectively. The inferred peak brightness temperatures were 0.6 K for W43 and 2.0 K for W51. This emission may be similar to the nonthermal 1720 MHz emission in dust clouds. (auth)

13531 ACCURACY OF THE MASS DETERMINATIONS OF NON-PULSATING BINARY X-RAY SOURCES. Van Den Heuvel, E. P. J. (Rijksuniversiteit, Utrecht); Ostriker, J. P. Nature (London); 245: No. 146, 99-100(15 Oct 1973).

It was thought that because of the importance of the possible detection of black holes in x-ray binaries it seemed useful to examine critically the uncertainties involved in the determination of the masses of the x-ray emitting components of binaries in which the visible component is an early-type supergiant and the x-ray source does not show regular pulsations. If an estimate of the mass of the early-type star is available a lower limit to the mass of the x-ray source can be derived from the mass function. It is shown that even if the distance, and thus the absolute luminosity, of the supergiant is known to a high accuracy its mass determination may still be in error by at least a factor of three. If the distance is unknown the system may have an extremely low mass and still show a supergiant spectrum. In an x-ray binary most of the outer layers of the massive early-type component may have been lost by mass exchange or mass loss from the system. As the He cores in normal early-type supergiants in the mass range between 20 and 40 $M_\odot$ contain about one-third of the stellar mass, it is expected that the uncertainty in mass determination of such stars in binaries will be at least by a factor of three and the question is discussed as to whether the observed characteristics of these stars show better clues to a more accurate mass determination; it is shown that this is not likely. For early-type supergiants, with the best spectral classification and the best possible distance determination, the uncertainty in the spectroscopic mass determination may easily be by a factor of two or more and for Of-type stars the situation is

even more uncertain. System parameters are listed for the three binaries Cyg X-1, 2 U 0900-40, and 2 U 1700-37, together with the possible mass range for their early-type components and the corresponding lower mass limits for the x-ray components. The only black hole candidate is Cygnus X-1, and the secondary in this system is very likely to be a black hole. (UK)

13532 ACCRETION AT A MAGNETIC POLE OF A NEUTRON STAR. Davidson, K. (Princeton Univ., NJ). Nature (London) Phys. Sci.; 246: No. 149, 1-4(5 Nov 1973).

It is stated that as accreted material falls to the surface of a magnetized neutron star, like Cen X-3 or Her X-1, it is arrested by radiation pressure in such a manner that a hot, dense mound of nearly stationary gas protrudes above each magnetic pole. Energy released above the mound diffuses out as moderately hard x rays; but that released within the mound emerges as soft x rays from the whole surface of the neutron star. (auth)

13533 ATOMIC PHYSICS AND ASTROPHYSICS. Volume 2. Chretien, M.; Lipworth, E. Brandeis University Summer Institute in Theoretical Physics, 1969. New York; Gordon and Breach, Science Publishers, Inc. (1973). 347p.

The three topics covered by these lectures were aspects of the physics of gas lasers, experimental x-ray astronomy, and atomic processes in astrophysics. (WDM)

13534 FINITE REST MASSES OF WAVE QUANTA IN INHOMOGENEOUS MATERIAL MEDIA. Cole, K. D. (La Trobe Univ., Bundoora, Australia). Aust. J. Phys.; 26: No. 3, 359-367(Jun 1973).

Snell's law is put in such a form that the bending of wave trajectories in inhomogeneous media can be compared with the bending due to a mechanical force field as deduced (Cole 1971). Two experiments are proposed to detect this bending effect. Though small in terrestrial conditions, the effect may be significant in the vicinity of some massive celestial objects such as pulsars. It is shown that the Coulomb law in a cold plasma is of Yukawa form in which the scale distance is c/ω_p where ω_p is the plasma frequency. This distance is the Compton wavelength of the particle defined by wave quanta in the plasma. (auth)

13535 FURTHER OBSERVATIONS OF CYGNUS X-3 AT GHz DURING THE SEPTEMBER 1972 OUTBURSTS. Aller, H. D.; Hodge, P. E. (Univ. of Michigan, Ann Arbor). Nature (London) Phys. Sci.; 245: No. 142, 40-41(17 Sep 1973).

Following the large radio event in Cygnus X-3 on September 2, 1972 a second large outburst was observed on September 19. A description is given of the results of measurements of the circular and linear polarization and the flux density made during the second and subsequent outbursts. All measurements were made with the Michigan University 85 ft paraboloid operating at 8 GHz. Observations of Cygnus X-3 were alternated every hour with observations of Cygnus A, which was assumed to have a flux density of 214 fu. Results are shown in tabular form. Four major outbursts with time scales of the order of days are evident in the data, together with a fifth small outburst. The emission from Cygnus X-3 was less than 0.5% polarized. The average circular polarization was +0.0034 ± −.0018, and the linear polarization 0.29 ± 0.18%. In spite of the absence of significant linear polarization the radio emission seems to have been produced by the synchrotron mechanism, and this absence could have resulted either from Faraday depolarization or because the magnetic field structure in the emitting region was highly disordered. The nature of the flux-density variations indicates that the injection of relativistic particles into the emitting region occurred over an extended period. It is suggested that the relativistic particles in Cygnus X-3 may be produced by some type of magnetic field amplification−annihilation mechanism. (UK)

13536 OPTICAL POSITIONS OF RADIO SOURCES. II. Veron, M. P.; Veron, P. (Tel Aviv Univ., Israel). Astron. Astrophys.; 28: No. 2, 319-320(Oct 1973).

Optical positions of 47 quasars were measured with an accuracy better than one arc second. The method of Schlesinger (1926) and for reference, stars from the AGK 3 catalogue was used. (auth)

13537 OBSERVED ANISOTROPY IN THE DISTRIBUTION OF RADIO SOURCES IN THE GB REGION OF THE SKY. I. Non-Randomness Distribution of the GB Sources. Maslowski, J.; Machalski, J.; Zieba, S. (Jagiellonian Univ., Krakow). Astron. Astrophys.; 28: No. 2, 289-294(Oct 1973).

The distribution of radio sources and their nearest-neighbor separations within the GB region of the sky is investigated. It is found that isotropy in the distribution of GB sources having flux densities greater than 0.09 f.u. (1 f.u. = 10^{-26} W m^{-2} Hz^{-1}) at 1400 MHz on a scale ranging from 30 square degrees up to a few hundreds of square degrees is out of question. It is concluded that the GB survey renders the hypothesis of isotropy in the distribution of weaker radio sources having 0.09 f.u. ≦ S(1400) < 0.5 f.u. highly improbable. The number of sources observed at any flux density level and in any flux density interval within the above limits varies significantly from place to place in the GB region. (auth)

13538 DISTANCE TO TYCHO'S SUPERNOVA (3C 10) AND THE NATURE OF 3C 58. Goss, W. M.; Schwarz, U. J.; Wesselius, P. R. (Kapteyn Astronomical Inst., Groningen, Netherlands). Astron. Astrophys.; 28: No. 2, 305-307(Oct 1973).

On the basis of 21-cm absorption measurements done with the synthesis radio telescope at Westerbork, the distances to 3C 10 and 3C 58 are discussed. 3C 10 (Tycho's supernova) is found to be more distant than previously thought (D ≧ 6 kpc). A high resolution map of 3C 58 is presented; this source is either at the edge of the Galaxy (D ≧ 8 kpc) or is extragalactic. (auth)

13539 OBSERVATIONS OF THE 21 CM ABSORPTION SPECTRA OF 3C 10 AND 3C 58. Williams, D. R. W. (Univ. of California, Berkeley). Astron. Astrophys.; 28: No. 2, 309-311(Oct 1973).

H I absorption spectra were obtained for 3C 10 and 3C 58. Absorption was measured up to a cut-off velocity of −65 km/s for 3C 10, and throughout the galactic range of velocities for 3C 58. The kinematic distances derived from these velocities were ≧5 kpc for 3C 10 and 8.2 kpc for 3C 58. (auth)

13540 PULSARS SPECTRA: A SUMMARY. Sieber, W. (Max-Planck-Institut fuer Radioastronomie, Bonn). Astron. Astrophys.; 28: No. 2, 237-252(Oct 1973).

Spectra of 27 pulsars were computed using pulse energy values observed with the 100-m and 25-m telescope of the Max-Planck-Institut fuer Radioastronomie at Effelsberg and Stockert and using other values published in the literature. Care was taken to ensure that various published pulse energy values were compatible. Four different models of the spectral behavior are discussed: (1) simple power-law, (2) synchrotron-self-absorption, (3) thermal absorption, and (4) a two-power-law model. The presented material indicates that at least 3 pulsars show a high-frequency "cut-off" and that 8 pulsars show a low-frequency turnover, which can be accounted for by absorption models. The computed values of the spectral index for the 27 pulsars lie between −0.7 and −3.3, the weighted average being −1.62 ± 0.37. (auth)

13541 RADIO OBSERVATIONS OF THE CYGNUS LOOP AT 2.7 AND 10.7 GHz. Keen, N. J.; Wilson, W. E.; Haslam, C. G. T.; Graham, D. A.; Thomasson, P. (Max-Planck-Institut fuer Radioastronomie, Bonn). Astron. Astrophys.; 28: No. 2, 197-201(Oct 1973).

Observations of the Cygnus Loop supernova remnant, made with the 100-meter radio telescope at 2.7 GHz and 10.7 GHz, reveal much new detail, and appear to confirm the conclusion of Kundu and Becker (1972) that radio emission from the source is predominantly on nonthermal origin. A detailed 10.7 GHz map of the small area around the radio maximum in NGC 6992, indicates only limited correspondence between radio and optical features at a resolution of ~1 arc min. An exceptional point source, located in the northern portion of the Cygnus Loop, has a flat spectrum and is time-variable at 10.7 GHz. This object appears to be physically associated with the supernova remnant. (auth)

Solar Phenomena

Refer also to abstracts 12963, 13347, 13704, 14135, and 14161.

13542 RELATION BETWEEN CORONAL λ 5303 INTENSITY, RECURRENT GEOMAGNETIC STORMS, AND SOLAR SECTOR STRUCTURE. Gulbrandsen, A. (Norwegian Institute of Cosmic Physics, Blindern, Oslo 3, Norway). J. Geophys. Res. 78: No. 22, 4787-4791 (1 Aug 1973).

A correlation is demonstrated between recurrent geomagnetic storms and longitudinal zones of low coronal λ 5303 intensity, called L zones. The onset of a storm occurs about 2 days after the central meridian passage of an L zone. The L zones partly coincide with regions of low brightness temperature at the 9.1-cm microwave emission. Comparison with data of the interplanetary sector structure suggests that an L zone is located to the east of a solar magnetic sector boundary. (auth)

13543 UBVr COLORS OF EXTREME POP II GIANTS. Boehm-Vitense, E. (Univ. of Washington, Seattle). Astron. Astrophys.; 24: No. 3, 447-458(May 1973).

The UBVr colors of Pop II giants with metal abundances 1/100 and 1/1000 times the solar metal abundances are computed. For these stars the Rayleigh scattering is extremely important for the U fluxes. The mean intensity J, the source function for the Rayleigh scattering, has been determined, considering not only

the continuous absorption of hydrogen and the metals but also the line absorption. The UBVr colors are given in the range $4200° \leq T_{eff} \leq 7700°$ and $4.6 \leq L/L_{\odot} < 1800$. From this the relation between B−V and T_{eff} is determined for different luminosities and also the ultraviolet excess, which for a given B−V depends on the gravity, g, as well as on the metal abundance Z. (auth)

13544 THERMAL CONVECTIVE INSTABILITY IN A MAGNETIZED ISOTHERMAL ATMOSPHERE. Singla, M.; Talwar, S. P. (Univ. of Delhi). Astron. Astrophys.; 24: No. 3, 441-446(May 1973).

The problem of thermal instability in a uniformly rotating magnetized atmosphere was investigated. The configuration was assumed isothermal and characterized by a constant Alfvén speed. The heat-loss mechanism was taken, for simplicity, to depend on temperature only. It was found than an instability arises for all nonzero magnetic fields in an otherwise stable (static) configuration characterized by a heat-loss parameter which is an increasing function of temperature. The uniform rotation enhances the growth rates of the monotonically unstable modes in a field-free configuration. (auth)

13545 CORONAL DENSITIES AND TEMPERATURES DERIVED FROM MONOCHROMATIC IMAGES IN THE RED AND GREEN LINES. Fort, B. (Observatoire de Meudon, France); Picat, J. P.; Dantel, M.; Leroy, J. L. Astron. Astrophys.; 24: No. 2, 267-273 (Apr 1973).

The electron densities and temperatures of the structures (arches and fans) were calculated using the most recent solutions of the ionization and statistical equilibrium equations for Fe X and Fe XIV in coronal conditions. The quiescent condensations are isothermal over the height range considered ($\rho < 1.2\ R_{\odot}$). Assuming cylindrical symmetry (to a first approximation) it was found that the electron density in the structures emitting the green line is about five times greater than in those emitting in the red line. The results are apparently in agreement with the relation: $\Delta \text{ Log } N = \frac{5}{2} \Delta \text{ Log } T$ obtained by Reimers (1971). Finally, since most of the coronal material is probably at least as hot as the regions which emit the green line, it is shown that the average electron density deduced from measurements of the white light corona, assuming a homogeneous distribution of matter, is probably underestimated by at least a factor 3. (auth)

13546 EXCITATION OF THE Fe XIII SPECTRUM IN THE SOLAR CORONA. Flower, D. R.; des Forets, P. (Observatoire de Paris, Meudon, France). Astron. Astrophys.; 24: No. 2, 181-192(Apr 1973).

The statistical equilibrium equations of the $^3P_{0,1,2}$, $^1D_2$ and $^1S_0$ levels of the ground $3s^2\ 3p^2$ configuration of Fe^{+12} were solved for the ranges of electron temperature, electron density, and geometrical dilution factor believed to be relevant to Fe XIII emission from the solar corona. Direct collisional and radiative transitions between these levels and indirect collisional excitation of allowed transitions to the $3s\ 3p^3$ and $3s^2\ 3p\ 3d$ configurations followed by radiative decay to the ground configuration were taken into account using new atomic data calculated in intermediate coupling allowing for the effects of configuration interaction. Particular attention was paid to assessing the remaining uncertainties in the atomic parameters. The indirect process was found to be the dominant collisional process in the statistical equilibrium equations. The variation of the λ 10747/λ 10798 and λ 3388/λ 10747 line intensity ratios are presented as functions of electron density and consistent values of the electron density of the emitting region were obtained when the calculated intensity ratios were combined with existing observations. (auth)

13547 Fe XVII EMISSION FROM THE SOLAR CORONA. Loulergue, M. (Observatoire de Paris, Meudon, France); Nussbaumer, H. Astron. Astrophys.; 24: No. 2, 209-213(Apr 1973).

Observations of Fe XVII in the 13 to 17 Å region from several rocket flights were combined and compared against theoretical intensities in the individual lines. These were calculated by solving the statistical equilibrium equations where Fe^{+16} was approximated by a 36 level ion. Collisional excitation from the ground level and from the first excited term and spontaneous radiative transitions among all the levels were included. The emission observed at 17.06 Å and attributed to an electric dipole intercombination transition is shown to be a blend of two lines at 17.05 Å and 17.10 Å; and the emission at 13.8 Å is a blend of two lines at 13.82 Å and 13.88 Å. The intensity ratios among the most commonly observed lines are insensitive to variations in T_e or N_e, the absolute emissivities are given as a function of these parameters. (auth)

13548 HARD X-RAY SOLAR BURSTS OBSERVED FROM THE OSO-6 SATELLITE. Brini, D.; Evangelisti, F.; Fuligni Di Grande, M. T.; Pizzichini, G.; Spizzichino, A.; Vespignani, G. R. (CNR, Bologna). Astron. Astrophys.; 25: No. 1, 17-27(May 1973).

A selection of hard x-ray bursts detected in the range 20 to 200 keV aboard the satellite OSO-6 is presented. A description is given of the treatment of data and the information that can be extracted from them, as afforded by the instrumental characteristics. The nature of the present results is such that features of hard x-ray bursts can be determined and correlated with other kinds of observations on a time scale of ≈ 1 minute. It is also shown how significant samples of events analyzed in this way can be used to investigate their group properties, bearing information on the physical processes involved. (auth)

13549 NEW OBSERVATIONS OF Fe XVII IN THE SOLAR X-RAY SPECTRUM. Parkinson, J. H. (Univ. of Leicester, Eng.). Astron. Astrophys.; 24: No. 2, 215-218(Apr 1973).

New observations of the Fe XVII lines between 13 and 18 Å in the solar x-ray spectrum are presented. The observations were made with a high resolution, collimated, crystal spectrometer, and all of the Fe XVII lines are clearly resolved, including the $2p^6\ ^1S_0 - 2p^5\ 3s\ ^3P_1$ and $^3P_2$ lines near 17 Å. The relative intensities of the Fe XVII lines are in good agreement with the calculations of Loulergue and Nussbaumer (1973) which include cascade processes. (auth)

13550 PHOTOMETRIC ANALYSIS OF MONOCHROMATIC PHOTOGRAPHS OF THE SOLAR CORONA TAKEN IN THE GREEN LINE (5303A) AND THE RED LINE (6374A). Picat, J. P. (Observatoire de Meudon, France); Fort, B.; Dantel, M.; Leroy, J. L. Astron. Astrophys.; 24: No. 2, 259-265(Apr 1973).

A photometric analysis of monochromatic photographs of the solar corona taken in the green line (5303 Å) and the red line (6374 Å) with a coronograph at the Pic-du-Midi Observatory is described. The morphology of the structures observed in the red line and the limits to the observations in the red and green lines are described, and intensity maps (in units of the mean photospheric radiation intensity) of the corona are presented. In certain cases, where the structures are well enough separated, the emission of individual structures is mapped. A series of numerical results which are independent of all theoretical assumptions (except that only one structure is observed along the line of sight) is presented and the data are provided for a study of the physical conditions in the coronal plasma. The intensity gradients observed in the red and green lines corresponding to both the general coronal emission and to the emission of the individual structures are also given. (auth)

13551 REGISTRATION METHODS OF THE SOLAR X-RAY RADIATION. Hlond, M. Postepy Astron.; 21: No. 3, 175-187 (Sep 1973). (In Polish).

A discussion of various methods used in registration of solar x rays is presented. (auth)

13552 SPHERICAL $\alpha\omega$-DYNAMOS BY A VARIATIONAL METHOD. Stix, M. (Univ.-Sternwarte, Goettingen, Ger.). Astron. Astrophys.; 24: No. 2, 275-281(Apr 1973).

Eigenvalues of the kinematic dynamo problem are obtained from a variational principle; the modes of free decay in an electrically conducting sphere are used as trial functions. This method is equivalent to an expansion method proposed earlier by Elsasser (1946a). An application to $\alpha\omega$-dynamos shows that a small number of trial functions often leads to quite accurate eigenvalues. The method is applied to Levy's (1972) dynamo model for the Earth. When the dynamo number is positive, this model favors indeed the steady dipolar field, as compared to oscillatory or quadrupolar fields. In the case of negative dynamo number the preferred field depends on the position of the cyclones (or "α-effect"): High- and mid-latitude cyclones maintain predominantly oscillatory dipole fields, low-latitude cyclones favor steady quadrupole fields. For mid-latitude cyclones the field tends to oscillate when the inductive effects are confined to the outer third of the sphere (as it is the case in the Sun). (auth)

13553 MYSTERY OF THE MISSING NEUTRINOS. Ryder, L. (Univ. of Kent, Eng.). Phys. Educ.; 8: No. 7, 484-485(Nov 1973).

Some years ago, a fairly serious discrepancy was discovered between the calculated rate at which neutrinos should be emitted by the Sun and the observed rate. Unlike many discrepancies, however, this one has not disappeared with improved experiments and more refined calculations. If anything, the situation has got worse, and the solar neutrinos now appear to present a major problem. The observed counting rate is less than one tenth of the smallest allowed theoretical estimate consistent with present theories of stellar structure and nuclear and particle physics. What has gone wrong? In this article the reasons for expecting neutrinos to be emitted by the Sun are outlined and

one or two possible resolutions of the problem and the implications are discussed. (UK)

13554 OBSERVATION OF AN INSTABILITY IN A QUIESCENT PROMINENCE. Stellmacher, G. (Institut d'Astrophysique, Paris); Wiehr, E. Astron. Astrophys.; 24: No. 2, 321-324(Apr 1973).

A cavity-like instability has been observed in a "quiescent" prominence. H_α-slit-yaw pictures are shown together with Ca^+ λ 8542 spectra taken with an image intensifier. The instability propagates almost with the phase velocity of MHD compressive waves. A violation of the lateral stability criterion in the Kippenhahn–Schlüter model is indicated, producing a material outflow along the lines of force. (auth)

13555 SOLAR SYSTEM AND ITS ORIGIN. Dormand, J. R. (Teesside Polytechnic Inst., Eng.). Phys. Educ.; 8: No. 7, 475-481(Nov 1973).

With the advent of space research, permitting more direct access to planetary bodies, new data on the solar system is now being amassed at a prodigious rate. Our planetary system is examined in the light of this information. The planetary orbits are described and the planets, asteroids, satellites, and comets considered. The origin of our planetary system is one of the central problems of theoretical astronomy. The criteria which a plausible theory of origin and evolution must satisfy are listed. The theories of Laplace (1796) who attributed the formation of the Sun and planets to the collapse of a rotating mass of gas and dust, and of Jeans (1928) who proposed a close encounter between the Sun and a more massive star, the nonuniform gravitational field of the star producing a large solar tide, are considered. Both fall down on the necessary criteria that the total angular momentum of the planets must be much larger than that of the Sun. More recently Hoyle (1960), Schatzman (1962), Huang (1973), Lyttleton (1961), Woolfson (1964) and Dormand and Woolfson (1971) have all postulated theories of the formation of our planetary system and these are briefly reviewed. Although many cosmogonists regard the satellite systems as miniatures of the main system and thus propose the same mechanism for their formation it is considered here that the differences between the two types of system are such that this is not so. (UK)

13556 TAIL PECULIARITIES IN COMET BENNETT CAUSED BY SOLAR WIND DISTURBANCES. Jockers, K.; Luest, R. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Astron. Astrophys.; 26: No. 1, 113-121(Jul 1973).

Peculiarities observed in the plasma tail of Comet Bennett between March 30 and April 7, 1970, were shown to be related to solar-wind events. In particular two series of exposures taken from stations at different geographic longitudes are discussed which show the development of a secondary tail. One of these events is clearly connected with an interplanetary shock wave. It is proposed that the ions forming the secondary tail originated in a region in front of the comet and were compressed during the shock event to a concentration dense enough to be observed. Further there seems to be a correlation between kinks in the tail axis and changes of the solar-wind direction. (auth)

13557 NUMERICAL CALCULATIONS OF ATOMIC STRUCTURE CONSTANTS. II. Radial Parts, Energy Levels, Transition Probabilities for Fe XIII. Bely-Dubau, F. (Observatoire, Nice). Astron. Astrophys.; 25: No. 3, 431-435(Jun 1973).

Employing the multiconfiguration Hartree–Fock method, the numerical evaluation of complex atom data is extended to the calculation of energy levels, wavelengths, and parameters relative to permitted transitions in intermediate coupling with configuration interaction. Application is made to Fe XIII. (auth)

13558 SOLAR DYNAMO AND ESTIMATES OF THE MAGNETIC DIFFUSIVITY AND THE α-EFFECT. Koehler, H. (Univ., Goettingen, Ger.). Astron. Astrophys.; 25: No. 3, 467-476(Jun 1973).

The dynamo equations including the α-effect are applied to axisymmetric magnetic fields in the solar convection zone. The unknown functions as magnetic diffusivity, α-effect and the law of rotation are discussed by adapting the theoretical butterfly diagrams to the observed ones. The estimates give an appreciable lower value for the magnetic diffusivity than that used in the literature. Computations with different laws of rotation show that the angular velocity must increase inside. The magnitude of the α-effect is estimated. (auth)

13559 EXPERIMENTAL OSCILLATOR STRENGTHS OF V I LINES. Mie, K.; Richter, J. (Univ., Kiel). Astron. Astrophys.; 25: No. 2, 299-301(Jun 1973).

Absolute f-values of 5 V I lines were measured with the atomic beam absorption method. The density in the beam followed from the velocity and the mass of evaporated material (determined by an x-ray fluorescence analysis). The results are in agreement with f-values which can be derived from beam foil measurements of atomic life times. (auth)

13560 GHOST LINES IN THE SOLAR SPECTRUM OF BURTON AND RIDGELEY. Palenius, H.P. (Harvard College Observatory, Cambridge, Massachusetts 02138). J. Opt. Soc. Am. 63: No. 9, 1176-1176 (Sept 1973).

Ghost lines in the grating spectrum of the sun are considered. The following formula $\lambda_g = \lambda(n \pm 270m/N)$ where λ_g = wavelength of the ghost, on the ghost order and n the diffraction order of the parent line of wavelength λ, provides an interpretation of the observed solar spectrum. (AIP) Index Headings: Gratings; Spectra; Hydrogen; Sun. (auth)

13561 NEUTRAL AND ION-EXOSPHERES IN THE SOLAR WIND WITH APPLICATIONS TO MERCURY. Hartle, R. E.; Ogilvie, K. W.; Wu, C. S. (Goddard Space Flight Center, Greenbelt, MD). Planet. Space Sci.; 21: No. 12, 2181-2191(Dec 1973).

A model of planetary neutral and ion-exospheres in the solar wind is formulated for weak or lunar like solar-wind interaction with a planet. The neutral exosphere model allows for density and temperature variations and for rotation at the exobase. The ion-exosphere is produced by ionization of the neutral exosphere in the solar wind and its density distribution is obtained by solving the continuity equation in the drift approximation. Applying to Mercury a surface temperature distribution inferred from infrared data and a vanishing bound neutral flux at the base, He and He^+ density distributions are found. When the He atmosphere of Mercury is due entirely to the surface bombardment by solar wind He^{2+}, the resulting He^+ density is found to vary from 1.5×10^{-1} to 10^{-3} cm^{-3} over the range 1.5 to 5 planetocentric radii on the dayside. These densities are found to be detectable by typical solar-wind plasma instruments. The possible effects of cyclotron-resonant scattering by interplanetary magnetic field fluctuations are examined and shown to be negligible. An electromagnetic plasma instability, triggered by the birth of ions in the exosphere, is shown to be important for the thermalization of the energy mode transverse to the interplanetary magnetic field, allowing more ions to be detected by solar-wind ion probes. (auth)

13562 OBSERVATIONS FROM SPACE OF THE SOLAR CORONA/INNER ZODIACAL LIGHT. Macqueen, R. M.; Ross, C. L.; Mattingly, T. (National Center for Atmospheric Research, Boulder, CO). Planet. Space Sci.; 21: No. 12, 2173-2179(Dec 1973).

Observations, from the Apollo 16 spacecraft, in lunar orbit, of the total radiance of the K + F corona, from 3 $R_\odot$ to 55 $R_\odot$ are presented and discussed. The logarithmic slope of the K + F coronal radiance, in the region $r > 20$ $R_\odot$, is found to be $n = 1.93$, slightly less steep than previous determinations. The photometric axis of the radiance is found to be displaced $3 \pm 1°$ north of the ecliptic, for the region $r > 20$ $R_\odot$, and this displacement is interpreted as an annual variation due to noncoincidence of the ecliptic and the symmetry axis of the zodiacal cloud. (auth)

13563 INVERSION OF THE MEAN AND SPATIALLY RESOLVED SODIUM D_2 LINE PROFILES FROM THE SUN. Holt, J. N.; Hearn, A. G. (Univ. of Queensland, Australia). Astron. Astrophys.; 27: No. 2, 297-302(Sep 1973).

A numerical technique for inverting a single line profile was applied to the mean and spatially resolved sodium D_2 line profiles. The mean profile gave a temperature distribution with optical depth which agreed with a standard atmosphere for the L.T.E. region of line formation. The density determinations from the inversion were not sufficiently accurate to measure the fluctuations between profiles. The inversion suggested that the line center intensity is formed in a complicated situation and is not suitable for correlation analysis. The inversion gave the source function at the edge of the L.T.E. region and its variation through the L.T.E. region. These parameters should be useful in correlation analyses. The temperature fluctuations obtained for the edge of the L.T.E. region agreed well with recent measurements in an infrared line of carbon monoxide. (auth)

13564 PITFALLS OF CONFIGURATION INTERACTION: TRANSITION PROBABILITIES IN Fe XIII. Nussbaumer, H. (Atomic Physics and Astrophysics, Zurich). Astron. Astrophys.; 27: No. 2, 303-306(Sep 1973).

With the example of Fe^{+12} the dangers of a deficient atomic eigenfunction expansion are demonstrated through the effects on resulting eigenvalues and transition probabilities. The example chosen concerns the multiplets $3s^23p^2\ ^3P - 3s3p^3\ ^1P^0$ and $3s^2\ 3p^2\ ^3P - 3s3p^3\ ^3S^0$ of Fe XIII the six lines of which have wavelengths 228 Å < λ < 252 Å; they may be observable in the coronal spectrum. (auth)

13565 MEASUREMENT OF THE SOLAR BRIGHTNESS TEMPERATURE AT 345 μ, 450 μ, AND 1000 μ. Gezari, D. Y.; Joyce, R. R.; Simon, M. (State Univ. of New York, Stony Brook). Astron. Astrophys.; 26: No. 3, 409-411(Aug 1973).

Measurements of the solar brightness temperature relative to the lunar brightness temperature were obtained from the ground at 345 μ, 450 μ, and 1000 μ. Measured values at these three wavelengths were 4541 ± 362°K, 4799 ± 380°K, and 5907 ± 413°K. These values appear to be in general agreement with the HSRA model and indicate that a strong upturn in the solar brightness temperature profile occurs at $\lambda > 500$ μ. The extinction measurements show that the transmissions in the 345, 450, and 625 μ atmospheric windows are very nearly equal to each other. (auth)

13566 COMPARISON STUDY OF THE PHOTOGRAPHICAL AND K-CORONOMETRICAL MEASUREMENTS OF THE JULY 10th 1972 SOLAR ECLIPSE CORONA. Baresu, C. (Institut d'Astrophysique, Paris). Astron. Astrophys.; 26: No. 3, 467-470(Aug 1973). (In French).

The K-coronometer measurements obtained at the Pic-du-Midi Observatory during the total eclipse of July 10, 1972 were compared with the data obtained for the same (2′ and 8′) radial distances from the solar limb, by performing absolute photometry of a photograph taken at Anadyr (URSS), using a neutral radial attenuator. The absolute calibration of the negative was made by assuming the Saito Model (Saito, 1970) for the F and K-coronas at $r > 2R_\odot$, and by taking the average brightness of the sky equal to: $13 \cdot 10^{-10}$ [$B_\odot$]. Satisfactory agreement, within a margin of error of about 10%, is found, provided it is assumed, at the west side, either a temporary variation of coronal intensity at 2′, or a slight decentring of about 15″ of the K-coronometer scanning. It is also assumed that the degree of polarization, p at 2′, is constant and equal to 0.30. At 8′, good agreement is obtained with p = 0.55; however, the structures projected on the south pole are less intense on the K-coronometer scanning, which indicates that they are not situated near the plane of the sky. (auth)

13567 ABSOLUTE OSCILLATOR STRENGTHS OF Si I LINES BETWEEN 2500 Å AND 8000 Å. Garz, T. (Univ., Kiel). Astron. Astrophys.; 26: No. 3, 471-477(Aug 1973).

Experimental data for oscillator strengths of Si I lines are quite scarce. Yet silicon is one of the most important elements in astrophysics. For this reason relative oscillator strengths for Si I lines between 2500 Å and 8000 Å were measured in emission in a wall-stabilized arc. The experimental equipment was similar to that used in previous investigations on Cu, Fe, and Ni by Kock et al. (1968-1970), but since the silicon was brought into the plasma under constant and reproducible conditions the spectra could be observed photoelectrically. The relative values were related to the absolute scale via absolute transition probabilities for principal lines in the UV, which could be determined from lifetimes measured by Marek in this laboratory in 1972. For the absolute oscillator strengths of lines in the visible and near infrared wavelength range, which are of particular astrophysical interest, the uncertainties are about 20 to 25%. (auth)

13568 OPTICAL HETERODYNE RADIOMETRY OF THE SOLAR SURFACE. Veth, C.; de Graauw, T.; Shelton, J. C.; van de Stadt, H. (Astrophysical Lab., Utrecht). Astron. Astrophys.; 26: No. 3, 479-482(Aug 1973).

The sensitivity of an optical heterodyne detector is shown to be sufficient for application to extremely high spectral resolution studies of the solar surface, in contrast with earlier predictions of Siegman (1966). Spectral resolutions of a few milli Angströms can be achieved with high signal-to-noise ratios and integration times of a few seconds. Scans of the solar surface have been made at 633 nm with an optical bandwidth of about 0.001 nm. (auth)

13569 SOLAR ABUNDANCE OF SILICON. Holweger, H. (Univ., Kiel). Astron. Astrophys.; 26: No. 2, 275-278(Jul 1973).

An analysis of 19 photospheric Si I lines whose oscillator strengths have recently been determined by Garz (1973) leads to a solar abundance of silicon, $\log \epsilon_{Si} = 7.65 \pm 0.07$, on the scale where $\log \epsilon_H = 12$. Together with the sodium abundance determined earlier by the same method, a solar abundance ratio $\epsilon_{Na}/\epsilon_{Si} = 0.045$ (±10%) results. Within the error limits this agrees with the meteoritic ratio found in carbonaceous chondrites. Results concerning line-broadening by hydrogen are discussed. (auth)

13570 COUPLING BETWEEN THERMAL CONDUCTION AND RADIATIVE TRANSFER IN A MOVING ATMOSPHERE. Frisch, H. (CNRS, Nice). Astron. Astrophys.; 27: No. 2, 223-229(Sep 1973).

A singular perturbation expansion method commonly used in boundary layer analysis is applied to the study of the coupling between thermal conduction and radiative transfer in a moving atmosphere. The expansion parameter is the conduction coefficient assumed to be small in suitable dimensionless units. The model consists of a plane slab of finite thickness heated by thermal conduction and loosing energy through emission of radiation. Boundary temperatures, incoming intensities and matter flux are given. In order to bring out the essential ideas the asymptotic expansion is performed on a linearized version of the equations. This restriction is however not essential. Conditions under which the equations may be linearized are discussed. It is shown that thermal conduction is essentially limited to a boundary layer near the hot end. A separate equation is obtained for the exterior region which is then used to find the conditions under which convection dominates over radiative transfer. Matched interior and exterior asymptotic expansions are given in special cases. (auth)

13571 RESONANCE SCATTERING FROM INTERSTELLAR AND INTERPLANETARY HELIUM. Paresce, F.; Bowyer, S. (Univ. of California, Berkeley). Astron. Astrophys.; 27: No. 3, 399-406(Sep 1973).

The intensity and spatial distribution of the diffuse 584 Å glow due to resonance scattering of solar He I, 584 Å line radiation by neutral interstellar and interplanetary helium are derived. Two sources of neutral helium are considered; the local interstellar medium interacting with the solar system and dust deionization of the He^{++} component of the solar wind. Which of these two sources will dominate the radiation field at 1 AU is dependent upon a number of parameters which have not yet been determined. Results are presented as a function of the width of the solar line, and the temperature and speed of approach of the interstellar medium. The calculated intensities for the most extreme cases vary from approximately 10^{-6} Rayleighs to almost 10^3 Rayleighs. The relevance of these results to the study of the interplanetary and interstellar medium is discussed. (auth)

13572 OBSERVATIONS OF TYPE I BURSTS AT 169 MHz AND CORONAL SCATTERING. Kerdraon, A. (Meudon Observatory, France). Astron. Astrophys.; 27: No. 3, 361-365 (Sep 1973).

Using the Nancay radioheliograph operating at 169 MHz, the center to limb variation of the angular size of Type I solar radio bursts emitted by a sample stable source was measured. It was found that this variation is small. This result can be explained by a scattering process by radially elongated inhomogeneities of the electron density in corona. It was also found that the bursts have an intrinsic size that can be produced by local effects. (auth)

13573 ATOMIC WAVELENGTHS AND TRANSITION PROBABILITIES IN THE INFRARED. Biemont, E.; Grevesse, N. (Univ., Liege). Astron. Astrophys.; 27: No. 1, 163-164(Aug 1974).

Infrared wavelengths ($1 \leq \lambda \leq 25$ μ) and oscillator strengths, based on the Coulomb approximation, were calculated for a large number of permitted lines of the following elements: Li I, Be I and Be II, B I, C I, N I, O I, Na I, Mg I and Mg II, Al I and Al II, Si I and Si II, P I and P II, S I, K I, Ca I and Ca II. (auth)

13574 ANALYTICAL APPROACH TO THE SOLAR NEUTRINO FLUXES. Chabas, J. (Univ., Barcelona). Astron. Astrophys.; 27: No. 1, 125-127(Aug 1974).

The solar neutrino fluxes on Earth obtained by means of a simple model are reported and new values of the flux-cross section product are derived. (auth)

13575 FURTHER OBSERVATIONS OF THE STRUCTURE OF THE CHROMOSPHERE-CORONA TRANSITION REGION FROM LIMB AND DISK INTENSITIES. Burton, W. M.; Jordan, C.; Ridgeley, A.; Wilson, R. (Culham Lab., Eng.). Astron. Astrophys.; 27: No. 1, 101-114(Aug 1974).

Further observations of limb to disk intensity ratios of emission lines in the euv solar spectrum were obtained on a Skylark rocket flight on August 5, 1971. Analysis of the data has shown that the observations support the existence of a steep rise in temperature in the transition region between $T_e \sim 6 \times 10^4$ °K and 3×10^5 °K. A decrease in temperature gradient above $T_e \sim 7 \times 10^5$ °K is observed. The absolute height of the transition region above the visible limb has been measured with a greater accuracy than previously possible and is 1700 km ± 700 km. An independent method using arc-length measurements of spectrum lines gives an absolute height of 2100 km ± 850 km. The absorption of lines lying at wavelengths shorter than the head of the Lyman continuum has been studied, and can be explained by spicular material with $N_e = 1.4 \times 10^{11}$ cm^{-3} and $T_e = 1.1 \times 10^4$ °K. The abundance of iron has been derived from the chromospheric emission lines of Fe II. This value agrees, within the experimental accuracy of a factor of two, with the value of $N(Fe)/N(H) = 4 \times 10^{-5}$ found from previous analyses of photospheric and coronal lines. (auth)

13576 PRACTICAL REPRESENTATION OF THE SOLAR MAGNETIC FIELD. Nakagawa, Y. (National Center for Atmo-

spheric Research, Boulder, CO). Astron. Astrophys.; 27: No. 1, 95-100(Aug 1973).

A practical method of representation of a class of force-free magnetic field B, characterized by $\nabla \times B = \alpha B$ with α being constant, on the basis of the observed line-of-sight component of the photospheric solar magnetic field in a spherical geometry is described. This method of representation can utilize the off-central meridian data and could provide a factor of N^2 (where N is the total number of data) reduction in the numerical procedure for the near-center meridian data in comparison with the method proposed by Altschuler and Newkirk for a current-free (the potential) magnetic field which is the case of $\alpha = 0$ in the present formulation. The details of the method of representation are presented together with discussions on the evolution of force-free magnetic field with a constant as well as a nonconstant α. (auth)

13577 STUDY OF MOLECULAR LINES IN THE SOLAR PHOTOSPHERIC SPECTRUM. Grevesse, N. (Univ., Liege); Sauval, A. J. Astron. Astrophys.; 27: No. 1, 29-43(Aug 1973).

The behavior of lines of C_2, CH, CN, MgH, NH, and OH in the solar photospheric spectrum was analyzed. Recently observed profiles of these lines were measured and compared with profiles computed using recent solar and molecular data. The main results of this comparison were: (I) there was good agreement between observed and calculated profiles for most of the molecular bands; (II) but large disagreements appeared in the case of CN and MgH; these discrepancies could not be explained satisfactorily, although different possible suggestions were investigated. A review of the different experimental band oscillator strengths is presented and mean laboratory values are proposed. (auth)

13578 INVERSION OF THE SOLAR LIMB-DARKENING EQUATION IN THE PRESENCE OF NOISE. Kunasz, C. V. (Univ. of Colorado, Boulder); Jefferies, J. T.; White, O. R. Astron. Astrophys.; 28: No. 1, 15-26(Oct 1973).

The formulation and application of the Phillips–Twomey method for inverting the integral equation of solar limb darkening in the presence of noise are discussed. It is shown through numerical experiments, that the method can be succesively applied to real data and that it has clear advantages over those standard methods that rely on the expression of the source function in an analytic form. In addition, some potentially interesting methods of a different kind, which are still under examination, are discussed. (auth)

13579 DIFFERENTIAL ROTATION IN STELLAR CONVECTION ZONES. II. Busse, F. H. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Astron. Astrophys.; 28: No. 1, 27-37(Oct 1973).

The analysis of an earlier paper (Busse 1970a) in which the differential rotation of the Sun was explained as the result of large scale convection in the solar convection zone is extended to include the detailed spatial dependence of the meridional circulation as well as of the differential rotation. The thin shell approximation for a rotating spherical convection layer of a Boussinesq fluid is used. The asymptotic representation of large order spherical harmonics by Hermite functions permits a simple integration of the equations for the meridional circulation and the differential rotation. Explicit analytical solutions are given for the case of stressfree boundaries and numerical results are shown in the case of a rigid inner and a free outer boundary. The case of stressfree boundaries is rather exceptional and the magnitude of the differential rotation is reduced for more general boundary conditions. However, the differential rotation still exhibits the characteristic equatorial acceleration in the case of an inner rigid boundary. (auth)

13580 MOLECULAR LINE FORMATION LEVELS AND ROTATIONAL TEMPERATURES IN SUNSPOTS. Boyer, R.; Sotirovski, P. (Observatoire de Meudon, France). Astron. Astrophys.; 28: No. 1, 151-153(Oct 1973).

The depth dependence of line formation for a group of selected MgH, MgO, TiO, and CN molecular lines in a sunspot was investigated. The sunspot model due to Hénoux was used to calculate molecular partial pressures P, selective absorption coefficients K_λ as a function of τ_0 (λ 5000 Å), and mean depths of formation τ^*. Values obtained for τ^* vary according to the bands studied: MgH (0,0) and (1,2) bands contain lines formed at $\tau^* = 0.015$ and $\tau^* = 0.40$ respectively; TiO (0,0) and MgO (0,0) lines are formed between $\tau^* = 0.22$ and $\tau^* = 0.45$, whereas TiO (1,2) and MgO (1,1) originate at deeper levels; the CN (6,1) band has lines formed in the region $\tau^* \gtrsim 1$. Two kinds of rotational temperature were determined for each molecular band: T_{RM} from measured equivalent widths and T_{RC} from equivalent widths calculated using the Hénoux model. Values of T_{RC} are systematically higher than T_{RM}. (auth)

13581 STUDY OF He I EMISSION LINES IN THE SOLAR ATMOSPHERE. II. The Infrared Lines at 10830 Å and 20581 Å. Streete, J. L.; MacQueen, R. M.; Tandberg-Hanssen, E. (National Center for Atmosphere Research, Boulder, CO). Astron. Astrophys.; 28: No. 1, 125-130(Oct 1973).

The 20581 Å line of the He I singlet series was observed for the first time in two quiescent prominences with a new all-reflective system. Simultaneously the corresponding triplet line at 10830 Å was observed and the triplet-singlet line intensity ratio was studied. While this ratio should have values around 45 for a prominence plasma in local thermodynamic equilibrium, the ratio was found to vary from about 125 to 575 in different parts of the prominences observed. From these data it was deduced that the ratio is determined by the optical depth in the 584 Å resonance line, whose net radiative bracket exhibits values between approximately 5×10^{-5} and 2×10^{-4}. (auth)

13582 TYPE IV SOLAR RADIO EMISSION AT 28.6 MHz. Subrahmanya Sarma, S. B. S. (National Physical Lab., New Delhi). Astron. Astrophys.; 28: No. 1, 137-140(Oct 1973).

Enhanced solar radio emission associated with solar activity was studied at meter wave lengths using single frequency records. It is shown that the Type IV radiation is recorded as a powerful point source in the position of the Sun at these wavelengths. A quantitative study of the time variation of the decay times and flux densities of these Type IV emissions is presented. It has been shown that these enhanced emissions show fair smooth variations and the flux densities decrease exponentially with time. The decay rates for each individual event were computed and these decay rates show an interesting typical uniform behavior. (auth)

13583 HANDBOOK OF ELEMENTAL ABUNDANCES IN METEORITES. Mason, B. (Ed.). Series on Extraterrestrial Chemistry. Volume 1. New York; Gordon and Breach, Science Publishers, Inc. (1971). 562p.

This volume is intended to bring together in one convenient source the extensive information about the abundances of the elements in meteoritic samples and to give some indication of the relative quality of this data. There is one chapter for each element which can be found in meteorites. (WDM)

13584 EVOLUTION OF THE SOLAR INNER ROTATION BY THE EDDINGTON–SWEET-TYPE CIRCULATION UNDER THE INFLUENCE OF THE SOLAR WIND TORQUE. Sakurai, T. (National Center for Atmospheric Research, Boulder, CO). Publ. Astron. Soc. Jap.; 24: No. 2, 153-176(Apr 1972).

The evolution of the axisymmetric rotation of the radiative interior of the Sun was investigated. The basic equations were derived within the framework of the Eddington–Sweet theory of perturbation. The effect of the molecular weight gradient built up by the proton–proton reaction and the effect of the solar-wind torque were taken into account. The initial state of the rotation was assumed to be rigid-body rotation and to have an angular velocity about 20 to 65 times larger than the present surface value. The numerical calculations were performed by the two-term approximation of the Legendre expansion. The results showed that the Eddington–Sweet circulation brings the angular momentum inwards to partially spin up (not spin down) the deep interior. The convection zone suffers a double extraction of the angular momentum: one from the above inner transport by the Eddington–Sweet circulation and the second from the solar-wind torque. Thus, the present decline of the surface angular velocity is faster than that for the case in which only the convection zone is spun down. The time the surface angular velocity takes to decline to the present value is estimated to be on the order of 10^7 to 10^8 years. This clearly shows the necessity of some mechanism which brings the angular momentum out from the solar interior. (auth)

13585 METALLIC ABUNDANCES IN THE SOLAR CHROMOSPHERE. Nakayama, K. (Kyoto Univ.). Publ. Astron. Soc. Jap.; 24: No. 2, 177-199(Apr 1972).

Abundances and excitation temperatures of metals in the low chromosphere were determined as functions of height using the 1962 eclipse data of the joint expedition of HAO and SPO, without the assumptions of local thermodynamic equilibrium and a constant source function. Lower term densities were determined from the self-absorption of flash lines, and estimations were made for the abundances of iron, titanium, chromium, scandium, strontium, barium, and zirconium. Excitation temperatures for most of the lines are shown to be decreasing in the outer regions of the atmosphere, but those for some of the lines exhibit the opposite behavior. Relative abundances of metallic elements in the upper layer seem to be the same as the photospheric values, but those abundances relative to hydrogen are increasing with height. It is likely that those apparent differences of relative

abundances between the upper and lower layers originate from inhomogeneties in the chromosphere. (auth)

13586 DISTRIBUTION OF URANIUM AND THORIUM AMONG COMPONENTS OF SOME CHONDRITES. Matsuda, H.; Shima, M.; Honda, M. (Tokyo Univ.). Geochem. J. (Nagoya); 6: No. 1, 37-42(Mar 1972).

The distribution of uranium and thorium was studied in the fractionated components of several chondritic meteorites. A wet fractionation method was applied to separate the component mineral groups of powdered samples of two olivine–hypersthene chondrites, one olivine–bronzite chondrite, and three enstatite chondrites. Uranium was determined in four samples and thorium was determined in all six samples. Both element determinations were by neutron activation. Uranium was found to be enriched in the HCl soluble fraction of the hypersthene chondrite Bruderheim, and of the enstatite chondrites, Abee and St. Marks, whereas it was enriched in the HCl insoluble fraction of the bronzite chondrite, Richardton. On the other hand, thorium was found to be relatively concentrated in the HCl soluble fractions of enstatite chondrites and in the HCl insoluble fractions of all the ordinary chondrites examined. In ordinary chondrites thorium behaves as a lithophile element, whereas in enstatite chondrites it seems to be partly chalcophile. (auth)

13587 CHROMOSPHERIC CONTINUUM OBSERVED AT THE TOTAL SOLAR ECLIPSE OF 12 NOVEMBER 1966 AND A MODEL OF THE LOW CHROMOSPHERE. Tanaka, K.; Hiei, E. (Tokyo Univ.). Publ. Astron. Soc. Jap.; 24: No. 3, 323-341(Jul 1972).

The authors have obtained the Balmer continuum and the continuum at 4000 Å in the chromosphere by observing the total solar eclipse of 12 November 1966. These data are in good agreement with those of previous eclipses. Existing chromospheric models are compared with comments. By using this eclipse data and the continuum at 6900 Å observed by MAKITA (1971) at the total solar eclipse of 7 March 1970, the authors have constructed a model chromosphere, which can explain the eclipse observations and also the observations of uv and mm radiation. In the authors' model the distribution of hydrogen density is equal to that of the NOYES and KALKOFEN (1970) model. The electron density and temperature lie between those of the NOYES and KALKOFEN (1970) model and of the Athay and CANFIELD (1970) model, respectively. (auth)

13588 INTENSITY RATIOS OF HeI AND H LINES IN A PROMINENCE AND THE CHROMOSPHERE. Kubota, J.; Tamenaga, T.; Yoshikawa, K. (Kyoto Univ.). Publ. Astron. Soc. Jap.; 24: No. 3, 343-354(Jul 1972).

The intensity ratios $I(D_3)/I(H\beta)$ and $I(D_3)/I(6678)$ in a prominence observed at the 1970 eclipse were studied by comparing monochromatic images in these lights. The ratio $I(D_3)/I(H\beta)$ was larger in the faint part of the prominence than in the bright part. This tendency can be found in quiescent prominences observed so far. The ratio $I(D_3)/I(6678)$ was nearly constant in the bright part, while in the extremely faint part the ratio was somewhat larger than in the bright part. Based on Ishizawa's (1972) calculation of the model hydrogen and the new calculation on HeI with seven discrete levels and the continuum, it is shown that the increase of the intensity ratio $I(D_3)/I(H\beta)$ can be interpreted as being caused by the decrease of the total number density of prominence matter in the faint part (total number density $N < 10^{11}$ cm^{-3}). The ratio $I(D_3)/I(6678)$ indicates that the excitation temperature of the resonance line λ 584 Å is nearly constant (11300 K) over the prominence. In the chromosphere, using the data at the 1962 eclipse, the ratio $I(D_3/I(H\beta)$ decreased with increasing height, and $I(D_3)/I(6678)$ was nearly constant throughout the observed heights. These may be due to the fact that the effective thickness of the emitting regions decreases with increasing height. (auth)

13589 FARADAY ROTATION OF LINEARLY POLARIZED RADIO WAVES FROM THE CRAB NEBULA BY THE SOLAR CORONA. Sofue, Y. (Nagoya Univ., Japan); Kawabata, K. A.; Kawajiri, N.; Kawano, N. Publ. Astron. Soc. Jap.; 24: No. 3, 309-321(Jul 1972).

Position angles of linearly polarized radio waves from the Crab Nebula (Tau A) were measured at wavelength λ = 7.2 cm, in the middle of June 1971, at which time the source was occulted by the outer solar corona. The observed variation in the rotation measure suggests that there exist local structures in the magnetic field and electron density of the corona. The local structures have two typical scale lengths of the order of 0.1 and 1 $R_\odot$, respectively, at a distance of 5 to 10 $R_\odot$ from the Sun. The field strength and electron density in the local structures are larger than the averaged values by a factor of 15 for the structures of scale length 0.1 $R_\odot$, and 4 for those of scale length 1 $R_\odot$. Observed values of the electron density and scale length of the local structures are the same, in order of magnitude, as those for coronal streamers. The direction of the magnetic field reverses in the large scale local structure, which is identified with a radial extension of a helment streamer. (auth)

Galaxies

Refer also to abstracts 13355, 13361, 13364, 13411, 13450, 13461, 13498, and 13664.

13590 APERTURE SYNTHESIS STUDY OF NEUTRAL HYDROGEN IN NGC 2403 AND NGC 4236. II. Discussion. Shostak, G. S. (California Inst. of Tech., Pasadena). Astron. Astrophys.; 24: No. 3, 411-419(May 1973).

For both NGC 2403 and NGC 4236 the extent of their H I distributions, as defined by 20% contour levels, is coincident with their optical extent. Both distributions exhibit bright, unresolved lumps situated in regions of prominent H II emission. The rotational velocities in NGC 2403 reach a maximum at 9 kpc, thereafter remaining relatively constant, thus suggesting that the bulk of this galaxy's mass lies outside its optical radius. NGC 4236, assumed to be a barred spiral, exhibits solid-body rotation over the length of the bar. Peculiar motions in NGC 2403 of ~10 km s^{-1} are observed, and are consistent in position and amplitude with the nonlinear density-wave theory of spiral structure. Upper limits to the fractional H I masses of these objects are 10% (NGC 2403) and 9% (NGC 4236). (auth)

13591 KINEMATICAL AND SPATIAL COINCIDENCE OF OPTICAL AND RADIO SPIRAL ARMS IN OUR GALAXY. Minn, Y. K. (Max-Planck-Institut fuer Radio Astronomie, Bonn); Greenberg, J. M. Astron. Astrophys.; 24: No. 3, 393-404(May 1973).

Radial velocity distributions of such spiral tracers as H I, H II regions, open clusters, and O associations in the outer part of the Galaxy are compared. It is found that the kinematics of the stellar objects is discrepant with that of the H I and H II regions. By comparing radial velocities of H II regions with their associated stellar objects, using the assumption that the distances of the H II regions are the same as those of the associated stellar objects, it is concluded that the velocity difference is not attributable to lack of spatial correlation. Rotation curves for gas and stars within 4 kpc of the Sun are compared with the Schmidt rotation curve and whereas the H II gas follows the Schmidt curve, the stellar objects diverge. A plausible theoretical explanation for the velocity differences between stellar objects and their associated H II regions is given on the basis of the density-wave theory of spiral structure. The well known apparent lack of spatial accord between the optical and radio spiral arms then seems to be explainable as a result of this kinematical difference between gas and stars. (auth)

13592 EVOLUTION MODELS OF THE INTERSTELLAR GAS. Gerola, H.; Iglesias, E.; Gamba, Z. (Universidad de Buenos Aires). Astron. Astrophys.; 24: No. 3, 369-378(May 1973).

A preliminary exploration of the hypothesis that all of the excitation state of the interstellar gas is due to supernova explosions is presented. From the fully time-dependent models presented it is shown that a statistical correlation among the observed parameters of the gas, neutral density, temperature, degree of ionization, exists and is of the same sense as that actually observed. Moreover, it is found that if a supernova outburst produces a particular initial structure of ionization in the neighboring gas, the observed numerical values of temperature, degree of ionization and density can be reproduced. Calculations presented also indicate that a model for the supernova outburst like that of Tucker (1971) could give rise to such particular ionization structure. (auth)

13593 DIFFUSE INTERSTELLAR LINES. Krebowski, J. (Instytut Astronomii, Torun, Poland). Postepy Astron.; 21: No. 3, 213-231(Sep 1973). (In Polish).

A brief review is presented of the available observational data concerning the diffuse interstellar lines. Attempts at theoretical interpretation of the diffuse lines are presented also. (auth)

13594 EFFECT OF LOOP III ON INTERSTELLAR NEUTRAL HYDROGEN. Fejes, I. (Univ. of Virginia, Charlottesville); Verschuur, G. L. Astron. Astrophys.; 25: No. 1, 85-91(May 1973).

Observations of neutral hydrogen along Loop III in the galactic region $152° < l < 167°$, $+21° < b < +31°$ are presented. An analysis of the velocity distribution of the gas shows that Loop III strongly affects the motion of the gas along its continuum ridges, but not in a way which could be explained by a supernova phenomenon. (auth)

13595 GALACTIC PLANE RADIATION AT 2.7 GHz. Keen, N. J. (Max-Planck-Institut fuer Radioastronomie, Bonn). Astron. Astrophys.; 24: No. 2, 299-301(Apr 1973).

Stable receiver and atmospheric conditions permitted measurements of the unresolved component of the galactic plane at 2.7 GHz. A value of $\beta = 2.85$ was obtained for the spectral index of the brightness temperatures between 820 MHz and 2.7 GHz. (auth)

13596 H I CLOUDS IN CLUSTERS OF GALAXIES. Smart, N. C. (Inst. of Astronomy, Cambridge, Eng.). Astron. Astrophys.; 24: No. 2, 171-180(Apr 1973).

It is proposed that the Coma Cluster of galaxies is bound by clouds of neutral hydrogen gas. These clouds will be optically thick to 21 cm line radiation so that their total emission will be less than the observed upper limit from the cluster. They must also be rotationally supported against collapse, for it is found that pressure supported clouds of a Jeans mass have a collision time $\ll$ a Hubble time. The rotationally supported clouds can be made more massive than a Jeans mass so a lower limit to their size can be determined by setting the collision time $\sim$ a Hubble time. These clouds also provide a mechanism for heating a diffuse gas between the clouds and galaxies to $\sim 7 \times 10^7$°K in agreement with the x-ray observations. Further, it is shown that if these clouds are present in all clusters, then the tests for the presence of H I in the intergalactic regions (e.g. 21 cm emission and absorption) are not stringent enough to limit this model. Finally, the ram pressure caused by the passage of the galaxies through the diffuse medium is sufficient to remove all the gas from inside the galaxies. This might explain the absence of spirals near the center of Coma. (auth)

13597 KINEMATICS OF A LOCAL COMPONENT OF THE INTERSTELLAR HYDROGEN GAS POSSIBLY RELATED TO GOULD'S BELT. Lindbald, P. O.; Grape, K.; Sandqvist, Aa.; Schober, J. (Stockholm Observatory). Astron. Astrophys.; 24: No. 2, 309-312(Apr 1973).

It is shown that a local component of the interstellar neutral hydrogen displays motions characteristic for a shell or cloud expanding in the field of differential rotation. A first order model gives an expansion age of $60 \cdot 10^6$ years. Some evidence is presented that this feature is related to the Gould Belt system of early type stars. The kinematic behavior of this feature may be related to the spiral shock model of galactic structure. (auth)

13598 LINE RADIATION TRANSFER IN EXTENDED ENVELOPES. I. Lyman-α Radiation in a Pure Hydrogen Nebula. Panagia, N.; Ranieri, M. (Laboratorio di Astrofisica Spaziale, Frascati, Italy). Astron. Astrophys.; 24: No. 2, 219-227(Apr 1973).

The transfer of Ly-α radiation in a spherically symmetric, pure hydrogen nebula was studied by means of Monte Carlo techniques. Three different distributions of emitters inside the nebula were assumed, which permit the description of a wide range of possible configurations. Calculations were performed for optical depths ranging from 10 to 10^4, assuming complete redistribution in the frequencies according to the Voigt profile. The results on the mean number of scatterings and the emergent profiles are extensively discussed. Comparison with other calculations are also made. The dependence of the mean number of scatterings from the nebular parameters, as well as the diffusion effects, is examined. (auth)

13599 MASS DISTRIBUTION OF OBJECTS UNDERGOING COLLISIONS WITH APPLICATIONS TO INTERSTELLAR H I CLOUDS. Taff, L. G.; Savedoff, M. P. (Univ. of Rochester, NY). Mon. Notic. Roy. Astron. Soc.; 164: No. 4, 357-379(1973).

A theoretical framework is presented in which to discuss the mass spectra of interacting species. It is applied to interstellar neutral hydrogen clouds. The theory predicts the number of objects of mass m per unit volume at time t, N(m,t). An equation for $\partial N(m,t)/\partial t$ is derived similar to the Boltzmann equation. Included in the kernel of the double integral, in addition to σv, is the central physical element of the theory, the conditional probability that once objects of mass m, m′ have collided they yield new objects of mass M,M′,..., M″. This quantity is symbolized by P(m,m′; M, M′, ..., M″). The mathematical structure of the system has been investigated and the results depend on the satisfaction of mass conservation, i.e., $(d/dt) \int mN(m,t)dm = 0$. The results of the theory for H I clouds are encouraging in that a statistical model of this nature, with sufficiently realistic P, can not only account for the observed, relatively flat, spectra in general, but have the capability of describing more complex distributions. For the theory to be viable the fragmentation of even nongravitationally bound clouds must almost never occur. The stability of such objects in the numerical calculations is assumed only for a time long compared to a collision time ($\approx 3 \times 10^6$ yr). The approximate existence of pressure equilibrium between H I clouds and the intercloud region is the theoretical justification of this. A short summary of a similar hypothesis in regard to the asteroid belt is given. (auth)

13600 OBSERVABILITY OF FAR INFRARED LINE EMISSION ORIGINATING FROM THE INTERSTELLAR MEDIUM. Pottasch, S. R. (Kapteyn Astronomical Inst., Groningen, Netherlands). Astron. Astrophys.; 24: No. 2, 305-307(Apr 1973).

Recent measurements of interstellar absorption lines in the ultraviolet, originating from energy levels above the ground level, can be used to directly compute the expected infrared line radiation. This is done for the λ 156 μ line of C^+ in the directions of ζ Oph and δ Sco, and lines of C^0, O^0, and Si^+. The computed line strengths are considerable and may be strong enough to be detectable with present techniques. (auth)

13601 PERSEUS SPIRAL ARM AT 21-cm. Verschuur, G. L. (National Radio Astronomy Observatory, Green Bank, WV). Astron. Astrophys.; 24: No. 2, 193-200(Apr 1973).

It is shown that the neutral hydrogen emission apparently associated with the Perseus spiral arm at latitude zero may be due to matter in a more distant spiral arm. The confusion arises because the velocity variation of the material in that arm is such that at latitudes greater than 3° the emission from the Perseus arm and the more distant arm are well separated in velocity, but at latitudes near zero they nearly blend. When this effect is recognized it is possible to account for the apparent difference between the neutral hydrogen velocities and the stellar velocities in the Perseus arm without invoking the presence of shock waves or other streaming motions in the Perseus arm. The velocity differences are the result of observing two different spiral arms while interpreting them as only one arm. When this effect is recognized it also becomes possible to more closely associate the neutral hydrogen in the Perseus arm with the optical absorption lines there and the anomalous velocities found may indeed be the result of clouds expanding away from the O-associations in the Perseus arm as suggested by Munch (1957). (auth)

13602 SURVEY OF ELLIPTICAL GALAXIES AT 6 cm. Ekers, R. D.; Ekers, J. A. (California Inst. of Tech., Pasadena). Astron. Astrophys.; 24: No. 2, 247-253(Apr 1973).

The results are reported of a 6 cm radio continuum survey of 191 E and SO galaxies with known redshifts. Nineteen galaxies were detected. These were reobserved at higher resolution and could be divided into well separated classes of compact and extended sources. The extended emission was found only in giant E galaxies whereas the compact radio sources were also found in less luminous E galaxies. This may affect the use of radio galaxies as standard candles in cosmology. The presence of optical emission lines is well correlated with compact radio emission. The possibility that the SO galaxies detected are in fact misclassified E or D galaxies is discussed. (auth)

13603 THERMAL AND IONIZATION EQUILIBRIUM IN A DENSE HYDROGEN CLOUD. Walmsley, M. (Max-Planck-Institut fuer Radioastronomie, Bonn). Astron. Astrophys.; 25: No. 1, 129-135(May 1973).

The equations of ionization and thermal equilibrium are solved as a function of radius for a dense ($n_H = 1000, 5000$ cm^{-3}) spherical homogeneous interstellar gas cloud. It is found that silicon is the most abundant ionized component in regions where carbon is neutral. Temperatures are in the range 5 to 15°K. The relationship of the models to carbon recombination line observations is discussed. (auth)

13604 GROWTH AND DESTRUCTION OF INTERSTELLAR GRAINS IN THE PRESENCE OF LOW-ENERGY COSMIC RAYS. de Jong, T.; Kamijo, F. (Sterrewacht, Leiden). Astron. Astrophys.; 25: No. 3, 363-370(Jun 1973).

Using the flux of low-energy cosmic rays postulated to account for the heating and ionization of the interstellar gas their interaction with grains was investigated. Since dirty ice grains with diameters smaller than 20 Å evaporate when hit by low-energy cosmic rays it is suggested that growth by condensation of the interstellar gas occurs on preexisting condensation nuclei with larger dimensions. Full-grown dirty ice grains are only gradually destroyed by sputtering and evaporation of surface atoms and molecules upon collisions with low-energy cosmic rays. Assuming that the binding energy of the grain material is low, about 0.1 eV, the most effective process is evaporation from a "hot spot" that is left behind on the grain surface after passage of a low-energy cosmic ray proton. It results in a destruction rate $dr/dt \leq 2.6 \times 10^{-22}$ cm s^{-1}. Considering the growth-destruction balance of interstellar grains in the framework of spiral density wave theory the following picture is arrived at: (i) Grains grow in dense clouds in a few times 10^7 years. Dust lanes in external galaxies are either explained by the formation of new dust during the passage of the compression wave (in a few times

10^7 years) or by sweeping dust clouds together in the compressed gas. (ii) Grains can be stripped of their dirty ice mantles in the intercloud gas by low-energy cosmic rays only if the efficiency of destruction is high (~ 1) and if the efficiency of condensation of clouds out of the hot gas is low so that the gas stays long enough in the hot phase (≳ 10^8 years). (auth)

13605 INFRARED 10μ EMISSION FROM CONDENSATION NUCLEI OF INTERSTELLAR GRAINS. Kamijo, F.; de Jong, T. (Sterrewacht, Leiden). Astron. Astrophys.; 25: No. 3, 371-377 (Jun 1973).

The particles emitting the 10μ excess radiation observed in the spectra of many late-type stars are assumed to provide the condensation cores of interstellar core-mantle grains. The rate at which silicate particles are produced by M supergiants is estimated from the 10μ excess of α Ori. If M giants, and possibly other late-type stars, also contribute to the total production rate, enough condensation nuclei with a radius of about 100 Å are produced to account for the presently observed interstellar grains. The 10μ flux observed from the Trapezium nebula in Orion is attributed to radiation of hot silicate cores, left behind after evaporation of the dirty ice mantles. Some implications for the extinction in H II regions and for the dynamical evolution of H II regions are briefly discussed. (auth)

13606 SIZE AND NATURE OF THE X-RAY SOURCE IN CEN A. Perola, G. C. (Instituto di Scienze Fisiche, Milan); Tarenghi, M. Astron. Astrophys.; 25: No. 3, 461-465(Jun 1973).

On the assumption that the low energy cut-off observed in the x-ray spectrum of NGC 5128 (Cen A) is due to photoelectric absorption, and that the x-ray source is concentric with the galaxy, the radio data in the continuum and the 21 cm line on the inner radio source of Cen A are used to set an upper limit on the size of the x-ray source of 1/2 kpc and 20 pc respectively if the absorbing gas is neutral or ionized. The nature of the source assumed coincident with the nucleus of the galaxy is then examined in the hypothesis of a synchrotron or inverse Compton origin of the x-rays. It is concluded that in both cases electrons of thousands of GeV or hundreds of MeV respectively need to be injected continuously, to compete with radiative losses and escape. (auth)

13607 NEW METHOD FOR DISTANCE ESTIMATES IN THE GALACTIC PLANE. Cahn, J. H. (Univ. of Illinois Observatory, Urbana). Astron. Astrophys.; 25: No. 3, 477-479(Jun 1973).

A procedure for estimating distances near the galactic plane is proposed, following the original work of Crézé (1972). The distances obtained depend upon independently determined extinctions and distances of planetary nebulae. For a given object, color excesses and celestial coordinates must be observed to estimate distance. More accurate distance can be inferred if the distance moduli, $m_v - M_v$, are observed. (auth)

13608 UPPER LIMITS TO THE H I CONTENT IN SEVERAL ELLIPTICAL GALAXIES. Bottinelli, L.; Gouguenheim, L.; Heidmann, J. (Observatoire, Meudon, France). Astron. Astrophys.; 25: No. 3, 451-454(Jun 1973).

Six bright elliptical galaxies were searched for neutral hydrogen 21-cm radiation with the Nancay radiotelescope. The observations showed that there was no 21-cm line whose width would be smaller than the spectral range of 900 km s^{-1}. However a line with width comparable to or larger than the spectral range would have of course escaped detection. With this restriction in mind, upper limits for neutral hydrogen content as small as a few times $10^9 M_\odot$ were obtained, in particular for NGC 4472. The relative amount of neutral hydrogen, compared either to luminosity, total mass or photometric diameter, is much lower for bright ellipticals than for lenticulars, thus providing a clear indication of a discontinuity in the integral properties of galaxies between the elliptical and the lenticular stages of the Hubble sequence. The low upper limit of neutral hydrogen content for NGC 4472 implies a mechanism able to remove the gas ejected from evolving stars which is hundred percent efficient in a time shorter than a few 10^7 to 10^8 years. (auth)

13609 DISCUSSION OF THE DISTRIBUTION OF INTERSTELLAR MATTER CLOSE TO THE SUN. Falgarone, E.; Lequeux, J. (Observatoire de Paris, Meudon, France). Astron. Astrophys.; 25: No. 2, 253-260(Jun 1973).

Using the new data of Radhakrishnan et al. (1972) and of Hughes, Thompson, and Colvin (1971), the distribution and kinematics of the interstellar clouds and of the hot intercloud medium are discussed separately. As shown by Radhakrishnan et al., the equivalent thickness of the cloud system close to the Sun is 330 pc, and its mean density at $z = 0$ is 0.29 atom cm^{-3}. The velocity dispersion between the clouds is shown to be isotropic and equal to 6.4 ± 0.9 km s^{-1}. Using the displacement of the line profiles of the intercloud medium due to differential rotation, it is shown that the equivalent thickness of the intercloud medium is 585 ± 100 pc; its density at $z = 0$ is 0.155 atom cm^{-3}, assuming a gaussian shape for the z-distribution. The equivalent thickness of the disk of interstellar thermal electrons is found to be of the order of 1 kpc or more, from a discussion of the dispersion, Faraday rotation, and interstellar scintillation of pulsars and extragalactic radiosources; this thickness is consistent with ionization of the intercloud medium by a uniform and steady flux of low-energy cosmic rays or soft x-rays. (auth)

13610 DIFFUSE GALACTIC LIGHT AND THE ALBEDO OF INTERSTELLAR DUST IN THE 1500 TO 4250 A REGION. Witt, A. N. (Ritter Astrophysical Research Center, Toledo); Lillie, C. F. Astron. Astrophys.; 25: No. 3, 397-404(Jun 1973).

The surface brightness of the night sky was measured with stellar photometers of the Orbiting Astronomical Observatory OAO-2 in 29 of Kapteyn's Selected Areas at ten wavelengths between 1500 and 4250 Å. Corrections for the starlight and zodiacal light included in the field of view (10′ Dia) were applied. The residuals were positive and showed a pronounced increase in magnitude with decreasing galactic latitude and were interpreted as diffuse galactic light. A comparison of the results with existing models for the radiative transfer of diffuse galactic light suggested a wavelength dependent albedo of the interstellar grains with a pronounced minimum around 2200 Å and a rapid increase towards values near unity at wavelengths shortward of 2000 Å. The scattering phase function is strongly forward scattering for wavelengths longer than 1900 Å and appears isotropic for wavelengths shorter than this limit. (auth)

13611 DISTANCE OF TWO GALAXIES IN STEPHAN'S QUINTET AND POSSIBLE NONVELOCITY REDSHIFTS. Balkowski, C.; Botinelli, L.; Chamaraux, P.; Gouguenheim, L.; Heidmann, J. (Observatoire, Meudon, France). Astron. Astrophys.; 25: No. 2, 319-324(Jun 1973).

21-cm line observations of two galaxies in Stephan's quintet were carried out with the Nancay radiotelescope: NGC 7319 with the high redshift cz = 6590 km s^{-1} and NGC 7320 with the low redshift cz = 755 km s^{-1}. From the measured H I fluxes and line widths, combined with optical data on magnitudes and photometric diameters, distances, D, were deduced for these galaxies using various distance criteria worked out in previous studies. These criteria are independent of the Hubble constant. It was found D = $(22^{+11}_{-5}$ m.e.) Mpc for NGC 7319 and D = $(12^{+6}_{-3}$ m.e.) Mpc for NGC 7320. It is then possible that both galaxies are at the same distance (≃ 17 Mpc). The probability for NGC 7319 to be at the cosmological distance corresponding to its redshift is only 1.3%. It is then possible that at least part of the redshift of NGC 7319 is anomalous. (auth)

13612 IONIZATION AND HEATING OF A LOW DENSITY PLASMA BY ENERGETIC PARTICLES. Aldrovandi, S. M. V.; Pequignot, D. (Observatoire de Meudon, France). Astron. Astrophys.; 26: No. 1, 33-43(Jul 1973).

The ionization and thermal equilibria of a gas with cosmic abundances heated by energetic particles were calculated in the range of temperature 10^3 to $10^{8.5}$K and in the range of number density 1 to 10^8 cm^{-3}. The elements considered were H, He, C, N, O, Ne, Mg, Si, and S. The cooling rates and line intensities of astrophysical interest are given as functions of temperature and total density. The reabsorption of the photons emitted by hydrogen and helium influences strongly the line intensities. (auth)

13613 PROBING THE INTERSTELLAR MEDIUM WITH A POINT EXPLOSION. Icke, V. (Univ. of Sussex, Eng.). Astron. Astrophys.; 26: No. 1, 45-52(Jul 1973).

The interstellar gas density ahead of a shock front caused by a point explosion is calculated, subject to the following simplifying assumptions: (a) the internal energy density of the gas before and after the explosion can be determined from an equation of state; (b) the velocity of sound in the interstellar medium is a known constant; (c) the shape of the shock front can be approximated; (d) the pressure behind the front is constant along the discontinuity. The precision of the method can be estimated by the calculation of the emissivity behind the shock and comparing this to observations. Approximations for the age, mass, and thickness of the shock front are also derived. The method is applied to the galactic object NGC 7635. It appears that an acceptable representation of the interstellar density around this nebula is given by $\rho = a(b + \exp(cz))$ where $a = 1.7 \times 10^{-20}$ kg m^{-3}, $b = 1.1$, and $c = -9.6 \times 10^{-17}$ m^{-1}. The age of the object is about 9×10^{12} s and the mass 2.4×10^{31} kg. The energy involved in the creation of NGC 7635 is approximately 8.4×10^{39} J. (auth)

13614 VARIATIONS OF THE RATIO OF THE Hα AND [N II] LINES THROUGHOUT THE NORTH AMERICAN (NGC 7000) AND PELICAN (IC 5070) NEBULAR COMPLEX. Goudis, C.; Meaburn, J. (Univ. of Manchester, Eng.). Astron. Astrophys.; 26: No. 1, 65-70(Jul 1973).

The variations of the ratios of the brightnesses of the Hα (6563 Å) and [N II] (6584 Å) lines were measured across the North American and Pelican nebular complex. Distinct variations were detected. These were converted into variations in the ratios of the volume emissivities of these lines by use of a shell model. The principal conclusions are that the ionization appears to be caused by a star or group of stars behind the dust lane and situated near the center of the radio contours. Moreover, strong evidence is presented which indicates that these nebulae are part of one H II region in which a huge dust lane is embedded. (auth)

13615 FINITE-AMPLITUDE DISTURBANCES IN SELF-GRAVITATING MEDIA. Tassoul, J. L.; Dedic, H. (Univ. of Montreal). Astron. Astrophys.; 26: No. 1, 79-84(Jul 1973).

The evolution of small but finite-amplitude disturbances in a self-gravitating fluid layer of finite thickness is considered. Contrary to the prediction of the linearized theory, the critical wavelength beyond which no small-amplitude motion exists now depends on the initial amplitude of the fluctuations. Nonlinearity slightly enlarges the range of unstable disturbances within the fluid slab. Typical nonlinear features in the flow patterns are observed. (auth)

13616 REDSHIFTS OF COMPANION GALAXIES. Bottinelli, L.; Gouguenheim, L. (Observatoire de Meudon, France). Astron. Astrophys.; 26: No. 1, 85-89(Jul 1973).

The study of the differential velocities of companion galaxies with respect to their main galaxy made by Arp is extended to the nearby groups of galaxies in which the main galaxy is at least 50% more luminous than each of the others. An effect similar to the one found by Arp is brought to light. The mean value of the radial velocity difference between the companion and the main galaxies is equal to 90 km s^{-1}. Three possible observational bias are considered which do not appear to be responsible of the observed effect. (auth)

13617 STUDY OF THE CENTRAL REGION OF M31. I. Spectrophotometric Observational Results. Joly, M.; Andrillat, Y. (Observatoire de Meudon, France). Astron. Astrophys.; 26: No. 1, 95-103(Jul 1973).

Some information about the stellar content of M31's central bulge is given. The spectrophotometric observational results obtained for a region of 3 kpc diameter, centered on the nucleus and divided into sections 250 pc long are described. It appears that the line intensities of Na I (λλ 5890 – 5896), Mg I (λλ 5167 – 5173 – 5184), Fe I (λ 4383, λ 3746, λ 3734, λ 3647), Ca II (λ 3933.68), and Cn (λλ 4100 – 4200) weaken as the distance from the center increases. There are also strong arguments in favor of variations of the intensities of the H (Hγ, Hδ, and Hε) and Ca I (λ 4226.74) lines and the CH band (G band at λλ 4283 – 4318). Among the studied elements, only Ni I (λ 3462, λ 3524.53) does not seem to suffer any variation throughout the nuclear bulge. (auth)

13618 OBSERVATIONS AT 1415 MHz OF RADIO SOURCES IN THE FIELD OF THE DOUBLE-GALAXY SYSTEM NGC 2798/99. Allen, R. J. (Univ. of Groningen, Netherlands); Sullivan, W. T. III. Astron. Astrophys.; 25: No. 2, 187-190(Jun 1973).

The radio sources in a field of about one square degree centered near the galaxies NGC 2798 and NGC 2799 were observed with the Westerbork Synthesis Radio Telescope in the continuum at 21-cm wavelength. On optical photographs, these two galaxies appear to be connected by a bridge of luminous material. The purpose of the observations was to search for further evidence of a physical interaction between these two galaxies in the form of bridges or jets of nonthermal radio emission. No such evidence in the present observations was found. One of the radio sources observed in this field is coincident with the nucleus of the SBap galaxy NGC 2798. Since physically isolated galaxies are occasionally radio sources, however, one can draw no inferences concerning a possible interaction with NGC 2799. In fact the estimated intrinsic radio power of NGC 2798 is well within the range for normal galaxies. A list of 10 other apparently unrelated radio sources which have been detected in the observed field is given, as well as a possible optical identification for one of them. (auth)

13619 FINE-STRUCTURE OF THE NEXT INNER SPIRAL ARM. Schmidt-Kaler, T.; Schlosser, W. (Ruhr-Universitaet, Bochum, Ger.). Astron. Astrophys.; 25: No. 2, 191-202(Jun 1973). (In German).

The spiral arms of the Galaxy are not just a phenomenon of the galactic plane. Because of the inaccuracy of current distance determinations of spiral tracers, any fine structure of the spiral arms has to be investigated by an analysis of the positions on the celestial sphere. Such fine structure perpendicular to the galactic plane is revealed by wide-angle photographs and photoelectric surface photometry of the Southern Milky Way in the ultraviolet. (WDM)

13620 AN ASSOCIATION OF H I AND Hα FILAMENTS. Verschuur, G.L. (National Radio Astronomy Observatory, Charlottesville, Virginia). Astron. J. 78: No. 7, 573-582 (Sept 1973).

A very striking H I ridge or filament ($1^{\circ} \times 15^{\circ}$ in size) has been mapped and this, as well as at least two related features, appears to be associated with a number of adjacent Hα filaments. The phenomena probably indicate the existence of an old, nearby, supernova shell. The observations are described in detail in this paper but a theoretical explanation for the existence of, and the similarity between, the H I and Hα filaments is lacking. (auth)

13621 THEORETICAL SUPPORT FOR THE ASSIGNMENT OF X-OGEN TO THE HCO^+ MOLECULAR ION. Wahlgren, U. (IBM Research Lab., Monterey, CA); Liu, B.; Pearson, P. K.; Schaefer, H. F. III. Nature (London) Phys. Sci.; 246: No. 149, 4-6(5 Nov 1973).

The term X-ogen line was applied to the first unidentified interstellar microwave line discovered in 1970, and the first two candidates suggested for X-ogen were HNC and HCO^+. Recent calculations have, however, ruled out HNC as a candidate, and reasons are given in favor of HCO^+. Four new galactic sources of the X-ogen emission line have recently been reported, and there is little doubt that X-ogen is an important interstellar species, and that polyatomic molecular ions may play an important role in the chemistry of the interstellar medium. It is clear that the confirmation or denial of HCO^+ as X-ogen would be extremely important. It has not proved possible to obtain a laboratory microwave spectrum of HCO^+ and a search for the $H^{13}CO^+$ rotational line analogous to X-ogen has proved fruitless. It is the opinion of the authors that ab initio calculations will provide the quickest route at least to partial clarification of the question, and the results of such a study are presented. Such calculations cannot, however, establish with complete certainty that X-ogen is HCO^+; a laboratory microwave measurement, the interstellar detection of an isotopic HCO^+ molecule, or a much more comprehensive calculation would be required for this purpose. (UK)

13622 SENSITIVE SEARCH FOR MICROWAVE PULSES FROM THE GALACTIC CENTRE. Partridge, R. B. (Haverford Coll, PA); Wrixton, G. T.; Pena, H.; Turner, K. C. Nature (London) Phys. Sci.; 245: No. 143, 53-55(24 Sep 1973).

A sensitive search for radio pulses from the galactic centre has been carried out using two receivers at ~1,500 MHz, spaced 10^4 km apart. Upper limits on the microwave flux lie twenty-five orders of magnitude below the pulsed gravitational flux reported. (auth)

13623 HIGH RESOLUTION OBSERVATIONS OF THE RADIO GALAXY NGC5128 AT 10.7 GHz. Price, K. M.; Stull, M. A. (Stanford Univ., CA). Nature (London) Phys. Sci.; 245: No. 145, 83-85(8 Oct 1973).

NGC 5128 (Centaurus A) is stated to be an important object for study since it should be possible to observe small scale structure that might not be resolved in more distant objects of the same class. It is at a distance of ~4 Mpc and is the nearest of the strong radio galaxies. There are three principal regions of radio emission associated with NGC 5128. The first, the "outer radio lobes", consists of two sources, one located to the north and the other to the south of the galaxy. The second is the "inner radio lobes", and consists of two components on opposite sides of the optical galaxy and separated by ~7 arc min. The third lies in the central regions of NGC 5128 and contains a compact nonthermal source that coincides in position with the infrared bright spot believed to lie at the nucleus. New high-resolution observations of radio intensity and polarization are here reported for the inner lobes and compact central source, which it is believed provide a significant new insight into the physical mechanisms responsible for radio and x radiation from this and other radio galaxies. The source was observed in the summer of 1973, using the five-element radiotelescope of the Stanford University Radio Astronomy Institute. At the observing frequency of 10.7 GHz the angular resolution of the Stanford array is 17 arc sec. The experimental procedure is described in detail. Scans for the SW and NE "inner radio lobes" are shown, and can be resolved into more than one component. The polarization data for the SW lobe show a remarkable picture; some of the six components show very high polarization, whilst others show low or negligible polarization. Furthermore the position angle changes from one component to another in a way correlated with the change in percentage of polarized flux. A very simple physical model is described to which the data can be fitted, and implications are discussed for other radio galaxies. Integrated fluxes were calculated. (UK)

13624 DETECTION OF INTERSTELLAR LITHIUM. Traub, W. A.; Carleton, N. P. (Harvard Univ., Cambridge, MA). Astrophys. J.; 184: No. 1, L11-L14(15 Aug 1973).

The 6708 Å absorption line doublet of interstellar ^{7}Li was ob-

served in the spectrum of ζ Oph, using a Pepsios high-resolution optical spectrometer. The lithium feature had a radial velocity of -14.9 ± 0.6 km s^{-1} with respect to the Sun and an equivalent width of 0.68 ± 0.09 mÅ. Within the detection limit, essentially no ^6Li was seen, so that $^7Li/^6Li > 7$. Using the observed Ca II to Ca I ratio, N(Li II) was calculated and it was found that, with respect to hydrogen, the lithium (and sodium) are depleted in the ζ Oph cloud to about one-sixth their solar-system values. (auth)

13625 ATTEMPT TO INTERPRET THE MEAN PROPERTIES OF THE VELOCITY FIELD OF YOUNG STARS IN TERMS OF LIN'S THEORY OF SPIRAL WAVES. Creze, M.; Mennessier, M. O. (Paris Observatory). Astron. Astrophys.; 27: No. 2, 281-289(Sep 1973).

Fitting Lin's theory for a disk galaxy affected by a spiral perturbation of the potential to the observed velocities of young stars allows one to estimate the free parameters of the spiral waves. The results are inconsistent with the ones derived from the large scale spiral structure. They suggest that Lin's theory may be unsuitable to the kinematics of young stars in the vicinity of the Sun. Various possible explanations are suggested. (auth)

13626 RADIAL VELOCITY MEASUREMENTS OF THE CETUS ARC NEBULOSITY AROUND LOOP II. Elliott, K. H. (Univ. of Manchester, Eng.). Astron. Astrophys.; 26: No. 2, 279-285(Jul 1973).

Observations of the Cetus Arc Nebula were made using a photographic Fabry–Perot interferometer, to obtain Hα radial velocities of over 100 points on the nebula. The velocities were determined to an accuracy of 5 km s^{-1} or better for positions which are known to within 1′. For a region of the arc between $\alpha = 4h\ 0m\ \delta = +2°$ and $4h\ 15m\ \delta = +9°$ a mean radial velocity of $+4.3$ km $s^{-1} \pm 0.6$ km s^{-1} was obtained. (auth)

13627 SMALL SCALE INDIVIDUAL FEATURES IN THE LOCAL NEUTRAL HYDROGEN. Baker, P. L. (National Radio Astronomy Observatory, Charlottesville, VA). Astron. Astrophys.; 26: No. 2, 203-214(Jul 1973).

The analysis of the small scale structure of neutral hydrogen emission is complicated by the problem of blending. A single spectral feature usually contains contributions from several spatial features in the line of sight. However, some spectral features may arise from single spatial features. These are termed individual features. A method for recognizing an individual feature has been developed and applied to a neutral hydrogen survey at negative intermediate galactic latitudes. The detected features fall into two classes. Some individual features appear to be disturbances in the velocity field, not the density field, of the gas. In addition to these kinematic disturbances, individual features are seen which resemble neutral hydrogen filaments. The kinematic disturbances are unevenly distributed on the sky. The individual features are exceptions to the normal hydrogen distribution and their existence points to the operation of physical processes which are exceptions to the normal processes governing the gas distribution. (auth)

13628 COMPARISON OF ROTATION CURVES OF DIFFERENT GALAXY TYPES. Roberts, M. S.; Rots, A. H. (Univ., Groningen, Netherlands). Astron. Astrophys.; 26: No. 3, 483-485(Aug 1973).

Rotation curves extending to large radial distances are now available for 3 spiral galaxies, each of a different type. Differences in shape of the rotation curves indicate a mass distribution that is related to structural type and is in the same sense as the luminosity distribution for these galaxies. The shapes of the rotation curves at large radii indicate a significant amount of matter at these large distances and imply that spiral galaxies are larger than found from photometric measurements. (auth)

13629 DYNAMICAL MODELS OF TAILED RADIO SOURCES IN CLUSTERS OF GALAXIES. Jaffe, W. J. (Leiden Observatory); Perola, G. C. Astron. Astrophys.; 26: No. 3, 423-435(Aug 1973).

Two models for the formation of "tailed" radio sources like 3C 129 are developed. Both models assume that the tails are the result of the rapid motion of an active galaxy through the relatively dense gas in a cluster of galaxies. The first model is a modification of current models of normal symmetrical double radio sources, with the effects of the motion of the parent galaxy and of the thermal pressure of the intracluster gas included. The second model assumes that the galaxy has a long, permanently attached, magnetospheric tail, similar to the geomagnetic tail, generated by the action of the intracluster gas flow on the intrinsic magnetic field of the galaxy. This tail is illuminated at intervals by outbursts of high energy electrons from the galaxy. An attempt is made to fit both models to 3C 129 to see if they give a good explanation of the observed characteristics of this source, and to determine the physical conditions in the intracluster gas. While both models give good fits to the shape of the tail, the magnetospheric model gives a better fit to the observed spectral indices, as well as resolving some difficulties in the interpretation of the polarization of the radio emission of 3C 129. The relation of the models to normal symmetric double radio sources, and to intermediate cases like 3C 465 is discussed. The derived values of the intracluster density and temperature are considered. (auth)

13630 BRIGHTNESS AND POLARIZATION DISTRIBUTIONS OF HEAD–TAIL GALAXIES AT 1415 MHz. Miley, G. K. (Leiden Observatory). Astron. Astrophys.; 26: No. 3, 413-421(Aug 1973).

Detailed 1415 MHz brightness and polarization distributions are presented for 3C 129, NGC 1265, and IC 310 with a resolution of $\sim 23'' \times 30''$. For each of the sources the percentage polarization increases with distance from the optical galaxy. A comparison of these data with previous 408 MHz measurements gives useful spectral information. It is suggested that 3C 129.1 is another example of a head-tail galaxy. (auth)

13631 STUDY OF THE REDSHIFT STRUCTURE OF THE COMA CLUSTER. Pineau des Forets, G.; Schneider, J. (Observatoire de Paris, Meudon, France). Astron. Astrophys.; 26: No. 3, 397-402(Aug 1973).

The redshifts for 168 galaxies in the Coma Cluster were compiled; mean velocities for elliptical and nonelliptical galaxies were calculated, and their mean values are respectively $\langle V_r \rangle = 6771 \pm 100$ and 6970 ± 100 km s^{-1}, the difference in velocities between ellipticals and nonellipticals being thus one standard deviation. This result, based on all available radial velocities within $R = 300'$ of arc of the cluster center, differs from that obtained by Tifft (1972) for a sample of galaxies within a core of radius $R \approx 20'$, and this difference which may be a statistical fluctuation or an effect found locally in the cluster core only is discussed. (auth)

13632 OBSERVATIONS OF NEUTRAL HYDROGEN NEAR THE GALACTIC CENTER. II. The Nuclear Disc. Sanders, R. H. (National Radio Astronomy Observatory, Green Bank, WV); Wrixon, G. T. Astron. Astrophys.; 26: No. 3, 365-377(Aug 1973).

Recent high-sensitivity, high-resolution 21-cm observations of the neutral hydrogen near the galactic center were analyzed with regard to the structure and kinematics of the gas in the galactic plane. Synthetic profiles were generated from model gas density and velocity fields, and these profiles were compared with observations. Several definite conclusions were drawn from the analysis: the gas density in the inner 500 pc of the galaxy must increase inward in a form similar to the star density; an upper limit of 10^8 $M_\odot$ may be placed on the mass of a condensed object or collection of objects at the galactic center; the random or turbulent velocity dispersion of the gas in the inner 500 pc is not large enough to account for the observed distribution of gas perpendicular to the plane; the gas distribution and kinematics in the inner 300 pc of the Galaxy is nonaxisymmetric in the sense of there being a deficiency of neutral hydrogen with high rotational velocities at positive longitudes. (auth)

13633 EFFECT OF HOT WHITE DWARFS ON THE INTERSTELLAR MEDIUM. II. Changes in Its Structure with Height Above the Galactic Plane and Some Consequences of the Finite Lifetimes and Velocities of the White Dwarfs. Hills, J. G. (Univ. of Michigan, Ann Arbor). Astron. Astrophys.; 26: No. 2, 197-202(Jul 1973).

Because the scale height above the galactic plane of the hot white dwarfs (UV stars) is greater than that of the interstellar gas, the interstellar medium above an average height $Z = 400$ pc from the galactic plane is completely ionized by the UV stars. If half the ionizing radiation from the UV stars above this Z escapes the Galaxy about ten percent of the ionizing photons emitted by the UV stars in the galactic disk escape the Galaxy. A Z-dependent model giving the average properties of the interstellar medium is calculated by assuming that all the ionizing photons emitted by the UV stars at a particular Z are absorbed by the gas at that Z. This model gives, as a function of Z, the fraction of the gas ionized, the fraction of the space occupied by H I clouds, the average density in the interstellar clouds, and the average radius of the interstellar clouds. A preliminary discussion is given of the effect of the finite lifetimes and nonzero velocities of the UV stars on the structure of the interstellar medium. It is demonstrated that these added factors have little effect on the types of average properties of the interstellar medium discussed in the first part of this paper and in the earlier paper (Hills, 1972), but they can account for an additional property of the interstellar medium which is not predictable from a static model, the presence of hot neutral hydrogen between the interstellar clouds. It is estimated that the quantity of hot neutral hydrogen in the intercloud medium is roughly a few times the observed amount of intercloud ionized hydrogen. (auth)

13634 PHYSICAL CONDITIONS IN NUCLEI OF SPIRAL GALAXIES. I. Study of Galaxies with a Nuclear Radio-component.

Alloin D. (Observatoire de Meudon, France). Astron. Astrophys.; 27: No. 3, 433-448(Sep 1973).

The nuclei of spiral galaxies were investigated. Their optical properties were examined in relation to the existence of a narrow radio-source in the nucleus. From the rough study of 89 nuclei of galaxies, it appears that optical emission lines are preferentially found in nuclei of the radio type. No other conclusions could be drawn, the published data being not precise enough. (WDM)

13635 RELATION BETWEEN REDSHIFT AND SURFACE BRIGHTNESS FOR NORMAL GALAXIES IN SYSTEMS OF GALAXIES. Jaakkola, T. (Univ. of Helsinki). Astron. Astrophys.; 27: No. 3, 449-457(Sep 1973).

The relation between the redshift of galaxies and their surface brightness was studied in clusters, groups, and pairs. Several surface brightness parameters were examined. In clusters and pairs redshift increased with mean surface brightness of the galaxy, but in groups such a dependence was not found. The following galaxies showed large frequencies of positive residual redshifts with respect to the mean redshift of the system: a) elliptical galaxies with high surface brightness; (b) galaxies with high surface brightness and steep edge-gradient of intensity; (c) components in double and multiple galaxies with smaller concentration of light toward the center than is the average for the system; (d) galaxies compact in the sense of the word used in CGCG (Zwicky et al., 1961–1968); (e) Sb and Sc galaxies with low nuclear surface brightness. Similar features of surface brightness often occurred in galaxies with discrepant redshifts. (auth)

13636 THERMODYNAMIC INSTABILITY CRITERION APPLIED TO ONE DIMENSIONAL STELLAR SYSTEMS. Finzi, U. (CEN, Grenoble, France). Astron. Astrophys.; 27: No. 3, 467-468(Sep 1973).

A general instability criterion based on statistical thermodynamics is applied to the exact nonlinear stationary solutions of the Vlasov–Poisson system for a double Water-bag distribution of self-gravitating matter. Perfect agreement is found with recently published results obtained by a linear perturbation stability analysis. (auth)

13637 GALACTIC STRUCTURE IN THE DIRECTION OF CEPHEUS. Barbier, M.; Bernard, A.; Bigay, J. H.; Garnier, R. (Observatoire de Marseille). Astron. Astrophys.; 27: No. 3, 421-427(Sep 1973). (In French).

Galactic structure in the direction $l^{II} \simeq 102°$, $b^{II} \simeq -1°$ is studied. Photometric and spectroscopic results, color excesses, and distances for 340 stars of spectral type earlier than A3 are presented. The area can be divided into three parts: a northern part quite dark, a southern part very clear, and a central part of intermediate darkness. The general histogram of distances and the localization of stars earlier than B2 show the local arm and two groups, the one located at a distance of about 2500 pc that might be an interarm, the other located at a distance of about 4200 pc, in the Perseus arm. These results are in good agreement with the distances of exciting stars near S 132 nebula. At this longitude, neutral hydrogen and interstellar calcium lines have two components which correspond to the radial velocities -30 km s^{-1} and -50 km s^{-1}, confirming the existence of these two groups. (auth)

13638 BENDING OF THE GALACTIC PLANE AND THE NATURE OF THE HIGH VELOCITY CLOUDS. Verschuur, G. L. (National Radio Astronomy Observatory, Green Bank, WV). Astron. Astrophys.; 27: No. 3, 407-411(Sep 1973).

The bending of the galactic plane and the increase in scale height with galactic-centric distance are measured in the first quadrant of galactic longitude. The results are applied to the spiral arms thought to exist in the second quadrant. If the Galaxy has a constant warp from $l = 20$ to 180° (it is possible that it warps more or less in the second quadrant) then qualitatively at least one can show that the high-velocity clouds seen at latitudes up to +50 or 60°, which have velocities of the order of those seen in distant arms near the plane, could be located at very large z distances in arms that arch well above the galactic disk. (auth)

13639 ELECTRONOGRAPHIC OBSERVATIONS OF THE [O II] RATIO IN THE CORE OF THE ORION NEBULA. Elliott, K. H.; Meaburn, J. (Univ. of Manchester, Eng.). Astron. Astrophys.; 27: No. 3, 367-372(Sep 1973).

Measurements were made with an electronographic image tube spectrograph of the [O II] ratio from over 350 separate areas of the dense core of the Orion Nebula. Each area was 3″ × 7″. The maximum of the systematic distribution of the local electron density is shown to be situated 30″ away from the Trapezium group of stars. Many large, small-scale fluctuations in the local electron density are demonstrated and a huge dust lane is also shown to be embedded in the ionized gas. Also a ring of, on average, higher density material is suggested around the Trapezium. (auth)

13640 MOTIONS NEAR THE GALACTIC CENTER AND THE 3-KPC ARM. Simonson, S. C. III; Mader, G. L. (Univ. of Maryland, College Park). Astron. Astrophys.; 27: No. 3, 337-350 (Sep 1973).

As a first approximation, the motions of the neutral hydrogen in the region between 1 and 5 kpc from the galactic center are found to be well represented in the $T_b(l,V)$ diagram by a disk in differential rotation, and no evidence is found for a general field of expanding motions. Consequently, a rotation curve for this region has been derived from the observations. The new curve indicates a more uniform distribution of mass in the inner region of the Galaxy than many previous models. In a second approximation, a set of parameters is derived for an elliptical dispersion ring that represents not only the "3-kpc arm" but also the "+70 km s^{-1} expanding arm" in the $T_b(l,V)$ diagram. The mean position of the dispersion ring, 4.0 ± 0.2 kpc from the center, corresponds to the inner Lindblad resonance of a two-armed spiral wave with an angular speed of 13 ± 3 km s^{-1} kpc^{-1}, and it coincides with a minimum in the new rotation curve, as expected if the resonant stars and gas feed angular momentum to the wave. A new pattern is proposed for the shape of the "expanding arm at +135 km s^{-1}" in the $T_b(l,V)$ diagram, which suggests a resonant orbit interpretation for this feature also. These resonant orbit models are compared with a model based on an explosion hypothesis. (auth)

13641 MODEL FOR THE MAGNETIC FIELD OF THE MAGELLANIC SYSTEM. Deinzer, W. (Univ., Goettingen, Ger.); Schmidt, T. Astron. Astrophys.; 27: No. 1, 85-88(Aug 1973).

A model is presented for the gaseous bridge and for the magnetic field connecting both Magellanic Clouds, according to optical and radio observations. Since an equilibrium configuration seems unlikely the time dependent problem was considered. Assuming cylindrical symmetry, a similarity solution of the equations of induction, of continuity, and of motion was found. The resulting time history of the Magellanic Bridge is summarized, taking the observational data from Hindman et al. (1963). A magnetic field of $\sim 10^{-6}$ Gauss, as suggested by observations, gives an age of $\sim 10^8$ years for the configuration, during which an expansion by about a factor 2 occurred. (auth)

13642 GALACTIC SPIRAL STRUCTURE FROM 21-CM DATA: A NEW MAP. Verschuur, G. L. (National Radio Astronomy Observatory, Green Bank, WV). Astron. Astrophys.; 27: No. 1, 73-76(Aug 1973).

A new map of the neutral hydrogen spiral structure outside the solar circle is presented. (auth)

13643 LUMINOSITY FUNCTION OF GALACTIC X-RAY SOURCES. Dilworth, C.; Maraschi, L.; Reina, C. (Univ., Milan). Astron. Astrophys.; 28: No. 1, 71-78(Oct 1973).

The spatial and intensity distributions of x-ray sources in the Uhuru catalog are discussed, and luminosity functions are derived for $L > 10^{35}$ erg s^{-1} for the galactic disk and for the central region. The fraction of the galactic x-ray background in the range 2 to 6 keV attributable to unresolved sources with the derived luminosity functions is found to be about 50%. In turn the limit imposed by the background on the density of x-ray sources with $L < 10^{35}$ erg s^{-1} is such that at most 10% of the Uhuru sources with isotropic latitude distribution could belong to the Galaxy. Considering the derived luminosity functions in relation to the three main groups of sources which can be distinguished in the sample covered by the survey of the UCRL group it is concluded that the disk sources belong to two main classes and the central sources to a third distinct class, distinguished by different properties of variability, temperature, and luminosity. (auth)

13644 PHOTOIONIZATION RATES IN INTERSTELLAR GAS. de Boer, K. S.; Koppenaal, K.; Pottasch, S. R. (Kapteyn Astronomical Inst., Groningen, Netherlands). Astron. Astrophys.; 28: No. 1, 145-146(Oct 1973).

Photoionization rates in the interstellar gas are calculated using OAO-2 data for the interstellar radiation density. A comparison is given with earlier results. (auth)

13645 RATE OF PRODUCTION OF IONIZING RADIATION BY HOT WHITE DWARFS AND UPPER MAIN SEQUENCE STARS IN GALAXIES. Hills, J. G. (Univ. of Michigan, Ann Arbor). Astron. Astrophys.; 28: No. 1, 63-70(Oct 1973).

Energy conservation dictates that hot white dwarfs (UV stars) produce about one percent of the stellar luminosity of most galaxies. Since this emission is largely in photons capable of ionizing hydrogen, there is a direct proportionality between the number of ionizing photons emitted by the UV stars in a galaxy. If the rate of production of the upper main-sequence O and B stars in a galaxy is proportional to the amount of gas being returned to the interstellar medium by evolving stars, there is also a direct proportionality between the number of ionizing photons

being emitted by the OB stars in a galaxy of a given morphological class and the luminosity of the galaxy. In this case the ratio of the number of ionizing photons emitted by the OB stars to the number emitted by the UV stars is the same for all galaxies of a given morphological class regardless of their individual luminosities. This ratio is estimated to be about 4 for Sb galaxies and to range from about 1.7 for SO galaxies to 26 for I galaxies. Using the knowledge of the rate of emission of ionizing photons, the equivalent widths of Hα and $[O\ II]_{\lambda\ 3727}$ in the integrated spectra of galaxies were calculated on the assumption that these galaxies have enough gas to absorb all the ionizing radiation emitted by the hot stars. Some cases where ordinary galaxies have anomalously large amounts of ionized gas which cannot be produced by radiation from conventional hot stars are noted and discussed. (auth)

13646 COSMIC BORON ABUNDANCE. Audouze, J. (Observatoire de Meudon, France); Lequeux, J.; Reeves, H. Astron. Astrophys.; 28: No. 1, 85-88(Oct 1973).

From the first results of the observations of uv interstellar lines made with the Copernicus ultraviolet observatory an upper limit of the interstellar boron abundance $n(B)/n(H) < 2 \times 10^{-9}$ in the direction of ξ Per is derived. Arguments based on this upper limit in interstellar matter, on the solar upper limit, and on the similarity between the meteorite abundance pattern of boron and mercury suggest a cosmic boron abundance of 5×10^{-10} (within a factor of two). (auth)

13647 SEARCH FOR H I OUTSIDE THE PLANE OF SPIRAL GALAXIES. Gerard, E. (Observatoire de Meudon, France). Astron. Astrophys.; 28: No. 1, 95-98(Oct 1973).

A search was made for 21 cm emission outside the plane of the six nearly edge on spiral galaxies (3 Sb's and 3 Sc's) NGC 247, NGC 891, NGC 3079, NGC 5907, NGC 7331, and NGC 7640 using the Nançay radiotelescope. No halo was found: the maximum H I column density was 3.2×10^{19} atom/cm^2 at a distance Z = 0.6 Holmberg radii from the plane and 1.4×10^{19} atom/cm^2 at Z = 1.0 Holmberg radii. More than 90 percent of the total H I mass is confined within |Z| = 0.4 Holmberg radii and more than 97 percent within |Z| = 0.6 Holmberg radii. (auth)

13648 EQUIVALENT WIDTH OF INTERSTELLAR MOLECULAR LINES. III. Equivalent Widths of the Bands (A-X), (B-X), (C-X), (D-X), (E-X), and (F-X) of CH and (A-X) of CH^+. Krishna Swamy, K. S.; Tarafdar, S. P. (Tata Inst. of Fundamental Research, Bombay). Astron. Astrophys.; 28: No. 1, 99-101(Oct 1973).

The equivalent widths of the bands (A-X), (B-X), (C-X), (D-X), (E-X) and (F-X) of CH and (A-X) of CH^+ were calculated for 3°K and various number densities. The method of determining the values of the Franck-Condon factors from astrophysical observations is discussed. The method is applied to the observed equivalent widths of CH^+ and H_2. (auth)

13649 APPARENT DISTRIBUTION AND VELOCITIES OF GALAXIES IN THE VIRGO CLUSTER AND ITS SURROUNDINGS. de Vaucouleurs, G.; de Vaucouleurs, A. (Univ. of Texas, Austin). Astron. Astrophys.; 28: No. 1, 109-118(Oct 1973).

A new detailed analysis of radial velocity data in the Virgo cluster confirms that a probably significant difference exists between the mean apparent velocities and velocity dispersions of the E, L-cloud: $\langle V_E \rangle = +1000 \pm 60$ with $\sigma_v \simeq 400$ km s^{-1} and of the S-cloud: $\langle V_S \rangle = +1350 \pm 150$ with $\sigma_v \simeq 750$ km s^{-1}. The different conclusion reached by Tammann (1972) is attributable to several causes which are analyzed. Possible interpretations of a velocity difference are reviewed. (auth)

13650 SIDEREAL PERIOD OF WEBER EVENTS. Shaham, J. (Univ. of Illinois, Urbana). Nature (London) Phys. Sci.; 246: No. 150, 25-26(12 Nov 1973).

It has been noted that an interpretation of Weber coincidence events in terms of gravitational radiation, originating in the galactic center, would suggest a galactic lifetime that is considerably smaller than indicated by existing astronomical and geophysical data. For that reason attempts have recently been made to find correlations between Weber events and Earth phenomena, with a view to finding other possible mechanisms to which at least some of the events could be attributed. There seems to be some correlation between the Weber events, terrestrial magnetic activity, and solar activity, and it has been suggested that the events may be caused by oscillations of the geomagnetic field, triggered by fast corpuscular solar streams. A strong argument in favor of the gravitational wave interpretation of the Weber events is their sidereal periodicity and their maximalization at the galactic center or anticenter. It is pointed out that such a periodicity may not, however, exclude the possibility that the events are of terrestrial origin. A sidereal periodicity, with a preferred direction towards the galactic center, could actually arise from a suitable "spin-orbit" coupling in the Earth, whether or not it is of particle-magnetic or other origin. (UK)

13651 FORMATION OF FORMALDEHYDE IN INTERSTELLAR CLOUDS. Dalgarno, A.; Oppenheimer, M.; Black, J. H. (Harvard Coll. Observatory, Cambridge, MA). Nature (London); 245: No. 146, 100-101(15 Oct 1973).

It is known that HCHO is widely distributed in the Galaxy, and in diffuse interstellar clouds its density appears to be typically several times 10^{-9}/cm^3. In order to explain its presence in dense clouds the following reactions have been proposed: (1) $HCO^+ + H_2 \rightarrow H_2 \cdot HCO^+ + e \rightarrow H \cdot CHO + H$ (dissociative recombination). The present authors suggest that the reaction $CH_2 + O \rightarrow HCHO + H$ is a most efficient source that may also be effective in diffuse clouds. In diffuse clouds containing H_2 the CH_2 is produced in a sequence of reactions initiated by $C^+ + H_2 \rightarrow CH_2^+ + h\nu$, the C^+ being provided by starlight photoionization of C. The reaction is followed by the fast reaction $CH_2^+ + H_2 \rightarrow CH_3^+ + H$. The resulting CH_3^+ may then undergo the following reactions: $CH_3^+ + e \rightarrow CH_2 + H$ or $CH + H_2$, and $CH_3^+ + O \rightarrow HCO^+ + H_2$ or $H_2\ CO^+ + H$. It is also possible to form CH_2 by the reaction $CH_2 + H_2 \rightarrow CH_3 + H$, but this reaction is very slow and does not constitute a significant source of CH_2 in interstellar clouds. Photo-dissociation and photoionization reactions in this system are also discussed—also charge transfer by heavy elements. (UK)

13652 VIOLENT TIDES BETWEEN GALAXIES. Toomre, A.; Toomre, J. Sci. Amer.; 229: No. 6, 39-48(Dec 1973).

Computer models for peculiar forms of interacting galaxies are developed to explain tidal distortions. (WDM)

13653 EXTREMELY COMPACT GALAXY CGCG 1622 + 4112. Karoji, H.; Kodaira, K. (Tokyo Univ.). Publ. Astron. Soc. Jap.; 24: No. 2, 239-246(Apr 1972).

Spectra of the extremely compact galaxy CGCG 1622 + 4112 were obtained with an image-intensifier spectrograph (λλ 3900 to 6600 Å, 220 Å mm^{-1}). By taking spectra of comparison stars with the same instrument, the spectroscopic data were analyzed quantitatively. The main conclusions are as follows: (1) the redshift of this object is 10250 ± 220 km s^{-1}; the cosmological distance is about 136 Mpc for H = 75 km s^{-1} Mpc^{-1}, and the size of the nucleus is less than 1.3 kpc. (2) The photographic absolute magnitude $M_{pg} = -20.2$ is within the range of that of normal galaxies. (3) The electron temperature $\log T_e = 4.36 \pm 0.30$ is found from the intensity ratio of [O III] lines. (4) The electron density $N_e \cong 1 \times \epsilon^{-\frac{1}{2}}$ cm^{-3} is estimated from the intensity of Hβ, where ε denotes the filling factor. (5) The mass of the halo is found to be $10^9\ \epsilon^{\frac{1}{2}}\ M_\odot$. (6) The continuous radiation from the nucleus follows a power-law $F_\nu \propto \nu^{-\alpha}$ with $\alpha = 2.0 \pm 0.4$ in λλ 4000 to 6000 Å, and may have excess over this law in the ultraviolet. It is suggested that luminous compact galaxies with sharp emission lines like CGCG 1622 + 4112, in contrast to low-luminosity compact galaxies with sharp emission lines, are close relative to compact galaxies with broad emission lines and Seyfert nuclei. (auth)

13654 DYNAMICS OF SELF-GRAVITATING MAGNETIZED CYLINDERS. Bhowmik, G.; Talwar, S. P. (Univ. of Delhi). Publ. Astron. Soc. Jap.; 24: No. 3, 365-373(Jul 1972).

The problem of finite amplitude radial oscillations in a uniformly rotating gravitating cylinder carrying a volume distribution of electric current is investigated adopting a Lagrangian description. Further, the radial motions caused by the introduction of a uniform rotation or a current system in an otherwise static configuration are also studied. (auth)

13655 COMPOSITION OF THE INTERSTELLAR GAS TOWARDS ZETA PUP. de Boer, K. S.; Pottasch, S. R. (Kapteyn Astronomical Inst, Groningen, Netherlands). Astron. Astrophys.; 28: No. 2, 155-158(Oct 1973).

uv-Interstellar absorption lines measured in the direction of ζ Pup by the S 59 satellite spectrograph are presented. These data are combined with other interstellar line measurements in the same star, to derive a curve of growth and element abundances. (auth)

13656 ROTATION AND MASS OF THE LARGE MAGELLANIC CLOUD. Prevot, L. (Observatoire de Marseille). Astron. Astrophys.; 28: No. 2, 165-179(Oct 1973). (In French).

From spectrographic observations at moderate dispersion (74 Å mm^{-1}) of 151 supergiant stars belonging to the Large Magellanic Cloud, a new position angle of the major axis at $\beta = 180°$ which is consistent with previous values was derived. The rotation curve showed clearly a keplerian branch starting at 2.4° and extending to 3.5° from the center of rotation. The curve was fitted with Perek's model which gave a mass within 3.5° of the center estimated to $0.43 \cdot 10^{10}\ M_\odot$ for n = 2, and with Brandt's model from which a total mass of $0.48 \cdot 10^{10}\ M_\odot$

was derived. The latter gave the best solution, leading to a mass–luminosity ratio of 1.4 and a mass of neutral gas-total mass ratio of 0.10, both in agreement with values currently admitted for late-type spiral galaxies. A short study of residual velocities gave a velocity dispersion of 10 km s^{-1} showing that the random motions are negligible. (auth)

13657 DENSITY OF THE INTERSTELLAR NEUTRAL HYDROGEN. Macchetto, F. (Laboratorio de Astrofisica Spaziale, Frascati, Italy); Panagia, N. Astron. Astrophys.; 28: No. 2, 313-314(Oct 1973).

Reanalysing the OAO–2 observations of Lyman–α interstellar absorption the contributions due to the diffuse interstellar hydrogen (that is the hydrogen present in the interstellar space as small clouds and intercloud medium) were separated from that due to large clouds. The mean density of the diffuse interstellar hydrogen was found to be $n_H = 0.35 \pm 0.10$ atom cm^{-3}. By comparing the Lyman–α absorption results with the extinction data a mean ratio $E_{B-V}/N_H = 0.18 \times 10^{-21}$ mag $atom^{-1}$ cm^2 was derived, fairly constant in all directions and for all the components of the interstellar medium. (auth)

13658 VARIATIONS OF THE GAS-DUST RELATION IN THE GENERAL INTERSTELLAR MEDIUM. Seki, M. (Tohoku Univ., Sendai). Astron. Astrophys.; 28: No. 2, 207-212(Oct 1973).

Regional variations of the relation between gas and dust are revealed in the neighborhood of the Sun by comparing galaxy counts with 21-cm hydrogen line data at $|b| \geq 10°$. Evidence is presented to show that the relation is not the same everywhere in the general interstellar medium, although neutral hydrogen is positively correlated with dust. Regional variations of the gas–dust relation occur on a rather large scale over the sky. These variations seem to be closely related to the local disturbance of the hydrogen layer in the vicinity of the Sun. (auth)

Cosmology

Refer also to abstracts 13489 and 14213.

13659 (COO-1112-192) INEVITABILITY OF GRAVITATIONAL COLLAPSE. Henyey, F. S. (Michigan Univ., Ann Arbor (USA). Dept. of Physics). [nd]. 22p. (UM-HE-72-35). Dep. NTIS $3.25.

It is proven that a sufficient accumulation of cold, uncharged, nonrotating matter cannot be stable against gravitational collapse. The highlights of the proof are: (1) fewer assumptions are made than previous arguments for collapse, in particular, the plausible, but unproved, "causality" assumption. (2) The amount of matter is measured by its baryon number, not its mass, since mass can be radiated away. (3) The precise analog of the argument that the Schwarzschild radius is proportional to the radius cubed does not suffice as a proof of the theorem for a very simple reason. As a result, it may be that an incompressible fluid is not the most resistant to collapse. (4) A crucial step in the proof appears to result from the details of the equations, and obvious physical insight into this mechanism is not provided. (auth)

13660 ABSENCE OF GRAVITY-WAVE SIGNALS IN A BAR AT 1695 Hz. Levine, J.L.; Garwin, R.L. (IBM Thomas J. Watson Research Center, Yorktown Heights, New York, 10598). Phys. Rev. Lett. 31: No. 3, 173-176 (16 July 1973).

A 118–kg bar shows vector amplitude changes ("impulses") in successive 24–msec intervals which correspond to bar energies E distributed with a probability $N = N_0 \exp(-E/kT_e)$, with $T_e \approx 30$ K. Not more than one impulse larger than 537 K was observed in 9 days. Calibration impulses giving the bar 600 K of energy were detected with 60% efficiency above a 537–K threshold. In the following Letter, these results are contrasted with the gravity-wave detections of Weber. (auth)

13661 AGE OF THE ELEMENTS. Schramm, D. N. Sci. Amer.; 230: No. 1, 69-77(Jan 1974).

The formation and spontaneous decay of ^{232}Th, ^{235}U, ^{238}U, and ^{244}Pu is reviewed. The rate supernovae prior to the formation of the solar system is discussed. The age of the Universe as derived from nucleocosmochronology is compared to the ages derived from expansion and globular clusters. (WDM)

13662 NULL SEARCH FOR BURSTS OF GRAVITATIONAL RADIATION. Tyson, J.A. (Bell Laboratories, Murray Hill, New Jersey, 07974). Phys. Rev. Lett. 31: No. 5, 326-329 (30 July 1973).

A calibrated detector of kilohertz-band gravitational radiation has been built which has sufficiently improved sensitivity over Weber's apparatus to allow comparison with his two-detector coincidence results. No events were observed by us at 710 Hz during a recent three-month period of observation. Weber's data at 1661 and 1030 Hz would imply that we should have seen more than 400 events. During these observations, our sensitivity to gravitational bursts was many times that of Weber during 1969–1970. Absolute limiting flux values are given. (auth)

13663 SINGLE GRAVITY-WAVE DETECTOR RESULTS CONTRASTED WITH PREVIOUS COINCIDENCE DETECTIONS. Garwin, R.L.; Levine, J.L. (IBM Thomas J. Watson Research Center, Yorktown Heights, New York, 10598). Phys. Rev. Lett. 31: No. 3, 176-180 (16 July 1973).

Coincidence detectors of Weber have given a 10:1 ratio (R^*) of prompt to delayed coincidences. Simplified analysis indicates that such an R^* would require daily gravity-wave incidence rate and energy depositions that would have been seen in the single-bar detector of the preceding Letter (and were not), suggesting that Weber's 1969–1970 events were not produced by gravity waves or that such waves do not exist in similar numbers and intensity in 1973. (auth)

13664 THE COSMOLOGICAL SIGNIFICANCE OF MOLECULAR BAND STRENGTHS IN THE INFRARED SPECTRA OF ELLIPTICAL GALAXIES. Tinsley, B.M. (Astronomy Program, University of Maryland). Astrophys. J. Lett. 184: No. 1, L41-L43 (15 Aug 1973).

Knowledge of the strength of the CO band at 2.3 μ in the spectra of giant elliptical galaxies would reduce substantially the uncertainty in the rate at which their absolute magnitudes evolve, and so contribute significantly to the determination of q_0. (auth)

13665 HAS THE UNIVERSE KNOWN A PRIMORDIAL EXPLOSION. Andrillat, H. (Univ., Montpellier, France). Astronomie; 87: 269-283(1973). (In French).

In spite of its attractive properties, Hoyle's model of the Universe has had to be abandoned, certain of his theoretical predictions having been found to be contradicted by observations, notably the recent enumerations of galaxies carried out by radio astronomy. Three models are used to diagram the Universe. The striking common point noted in examining these models is the fact that, contrary to Hoyle's model, the universal expansion which they translate does not cover an infinity of time. It commences at a definite instant, which can be chosen as the initial instant, and in that unique point where the radius of the Universe is zero and the tangent to the possible curves is vertical. The expansion is thus explosive at this point, while the later variation of the tangent of the curves is rapid. These are models of a primordial explosion. (IAA)

13666 SELFGRAVITATING WINDS. Biermann, P.; Kippenhahn, R. (Univ., Goettingen, Ger.). Astron. Astrophys.; 25: No. 1, 63-70(May 1973).

The general properties of stationary isothermal flows under the influence of selfgravitation are considered. Only cases of high symmetry are discussed: a) the plane-parallel flow, b) the spherically symmetric flow, and c) the rotationally symmetric flow. Oscillatory solutions in the subsonic regime and under certain conditions smooth transitions from subsonic to supersonic flow are found in all cases. (auth)

13667 STEFAN–BOLTZMANN LAW AND CORRECT STATISTICS FOR THE NEUTRINO SEA. Kuchowicz, B. (Univ., Warsaw). Lett. Nuovo Cim.; 8: No. 16, 942-944(15 Dec 1973).

It is argued that the Fermi–Dirac statistics is the correct statistics for the neutrino sea and yields the generalized Stefan–Boltzmann law for the neutrino power flow. (LBS)

13668 APPLICATIONS OF RELATIVISTIC KINETIC THEORY TO COSMOLOGICAL MODELS: SOME OBSERVATIONAL CONSEQUENCES. Hakim, R. (Faculte des Sciences, Montpellier, France); Vilain, C. Astron. Astrophys.; 25: No. 2, 211-217(Jun 1973).

A gas, consisting of clusters of galaxies, was studied using kinetic theory. It was assumed to have been in equilibrium at some arbitrarily earlier epoch, and to have the density observed at the present time. The model was also assigned a finite pressure. An equation of state was abstracted together with a number of observables: these were used to establish a comparison with other Friedmann models. The actual computations were performed for the magnitude redshift diagram with a particular velocity distribution, and a comparison with observation lead to the conclusion that when clusters of galaxies are treated as test particles, their random velocities do not exceed some value close to 4500 km/s. The significance of this result, and also some other applications of the same model, are discussed. (auth)

13669 ROLE OF THE ELECTRON–NEUTRINO INTERACTION IN THE PRIMORDIAL GAS. Hecht, H. F. (Univ., Karlsruhe, Ger.). Astron. Astrophys.; 26: No. 1, 123-125(Jul 1973).

The results of some calculations concerning the importance of the electron–neutrino interaction in the primordial gas are reported. Since the total strength of this interaction is not very well established, deviations from the currently accepted value are

allowed and the ramifications in the early stages of cosmological evolution are computed. (auth)

13670 LINEARITY AND PARAMETRIZATION OF GRAVITATIONAL EFFECTS. Deser, S. (Univ. Paris-Sud, Orsay, France); Laurent, B. Astron. Astrophys.; 25: No. 2, 327-328(Jun 1973).

It is argued on two grounds that the conventional parametrized post-newtonian (PPN) formalism is unsuited for the discussion of gravitational nonlinearities. (auth)

13671 IMPLICATIONS OF THE STATISTICAL BOOTSTRAP MODEL FOR COSMOLOGY AND GALAXY FORMATION. Carlitz, R.; Frautschi, S.; Nahm, W. (CERN, Geneva). Astron. Astrophys.; 26: No. 2, 171-189(Jul 1973).

The statistical bootstrap model suggests that the hadron level density is $\sigma(m) \sim Cm^{-3} \exp(m/T_h)$. With a spectrum of this type, massive hadron resonances will predominate in the early stages of the big bang, and the Universe will evolve out of equilibrium. The decay chains of these resonances may be so lengthy that the hadron era is prolonged far past its conventional end. The subsequent radiation era will be considerably foreshortened with the following major consequences. (i) Large density fluctuations are produced during the hadron era. The foreshortened radiation era is insufficiently lengthy for these fluctuations to be damped out. Thus, unlike conventional models, this model allows the causal development of galaxies from an initially homogeneous and isotropic state. (ii) During the hadron-dominated era a secondary gas of photons, leptons, and baryons builds up from the products of hadron decay. This secondary gas comes into equilibrium allowing the production of the present day 3° blackbody radiation despite the foreshortening of the radiation era. The buildup of the secondary gas involves the production of a considerable amount of entropy and thus helps in explaining the presently observed magnitude of the entropy density. (auth)

13672 GENERATION OF MAGNETIC FIELDS IN A MATTER–ANTIMATTER UNIVERSE. Aly, J. J. (Laboratoire d'Astrophysique, Meudon, France). Astron. Astrophys.; 26: No. 3, 457-461(Aug 1973).

A mechanism capable of producing magnetic fields in the early stages of Omnès' baryon-symmetric Universe was studied. It is shown that the Compton effect of high-energy photons produced during matter–antimatter annihilation generates electric currents in the cosmic plasma and therefore magnetic fields. Plasma effects, such as the excitation of a reverse current which tends to cancel the original one and consequently to decrease the field, are taken into account. The seed field generated by this process is found to be of the order of 10^{-11} G for a redshift $z = 10^3$ (just before the recombination period); it can be subsequently amplified by the annihilation generated turbulence. (auth)

13673 GREEN BANK SKY SURVEY IN SEARCH OF RADIO SOUFCES AT 1400 MHz. IV. Anisotropy and Counts of Radio Sources. Maslowski, J. (Jagiellonian Univ., Krakow). Astron. Astrophys.; 26: No. 3, 343-347(Aug 1973).

Further observational evidence for anisotropy in the distribution of weaker radio sources (0.5×10^{-28} W m^{-2} Hz^{-1} at 1400 MHz) on a scale of tenths of steradian is given. It is based on the source counts derived from the two 1400 MHz source surveys of two different regions of the sky, namely the GB region (Maslowski, 1971, 1972 a,b) centered at declination about +49° and the GA region (M. M. Davis, in preparation) centered at declination +27°. It is shown that the source counts from these two regions of the sky differ significantly at a confidence level of at least 98%. Cosmological and astrophysical consequences of the observed anisotropy in the source distribution are also discussed. (auth)

13674 GALAXY FORMATION FROM PRIMEVAL UNIVERSAL TURBULENCE. II. Dallaporta, N.; Lucchin, F. (Univ., Padua). Astron. Astrophys.; 26: No. 3, 325-333(Aug 1973).

The problem of galaxy formation through separation from the continuous matter background due to density fluctuations is reconsidered in the frame of the primordial turbulence theory, according to the general outline of the problem given by Ozernoy and collaborators. Account is taken of dissipation losses in the turbulence, which were neglected in the previous treatment of the problem. (WDM)

13675 FORMATION OF GALAXIES INSIDE CLUSTERS. Icke, V. (Univ. of Sussex, Brighton, Eng.). Astron. Astrophys.; 27: No. 1, 1-21(Aug 1973).

A model is presented for the formation of clusters of galaxies, after the decoupling of radiation from matter in an Einstein–DeSitter Universe. It is assumed that due to primeval turbulence in the Universe some spheroidal regions of space expand somewhat slower than others. These slow-expansion regions, which have a mass between 10^{45} and 10^{47} kg, eventually stop expanding and subsequently collapse to high density. If such a region is not exactly spherical its deviation from sphericity will increase throughout the evolution. The turbulence inside this protocluster leads to the formation of galaxies. In order to study this formation, the growth rate of perturbations of a collapsing prolate spheroid is determined. The protocluster is assumed to be prolate because then the density enhancement is much larger than with an oblate spheroid. The protoclusters collapse within about 10^{17} s predominantly into highly elongated clusters. The time needed for a galaxy to cross such a cluster along its major axis is about 4×10^{17} s so that many of these clusters have not yet reached virial equilibrium at the present time. (WDM)

13676 MATTER–ANTIMATTER COSMOLOGY: THE RADIATIVE PERIOD. Aldrovandi, R. (Universite de Paris-Sud, Orsay, France); Caser, S.; Omnes, R.; Puget, J. L. Astron. Astrophys.; 28: No. 2, 253-266(Oct 1973).

The kinetics of high-energy particles produced along the boundary of the matter–antimatter emulsion of a symmetric universe during the radiative period is analyzed. It is shown that there exists a pressure discontinuity across the boundary which is of the Laplace–Kelvin form, thus implying the existence of a coalescence effect. The kinetics of thermal photons is also studied and hydrodynamical equations are derived for the radiation and plasma components. The annihilation rate at the boundary is computed and the rate of growth of the emulsion with time is derived by averaging over a large volume. The mean mass of galaxies is roughly estimated and found to be comparable with the observed value, which proved the efficiency of the coalescence process. No hydrodynamical instability or large scale turbulence occurs during the radiative period, and the effect of small scale turbulence is found to be negligible. Magnetic field effects have not been investigated although they may become important after recombination. The above results remain essentially valid whatever the initial mechanism for matter–antimatter separation. (auth)

Planetary Phenomena

13677 (ANL-7996, pp 45-49) GEO- AND COSMOCHEMISTRY AND ARCHAEOLOGY. Feb

In chemistry division annual report, July 1971–June 1972.

Content of ^{238}U and ^{237}Np in lunar samples was determined. Data from trace studies on lunar samples have been published elsewhere. Studies on the mineralogy of meteorites and lunar, the origin of organic matter in the early solar system, and archaeological problems are summarized. (JGB)

13678 (JPRS–60945) PRELIMINARY RESULTS OF STUDYING THE PLASMA NEAR THE MOON. Vasil'ev, M. B.; Vyshlov, A. S.; Kolosov, M. A.; Savich, N. A.; Samovol, V. A.; Samoznaev, L. N.; Sidorenko, A. I.; Shtern, D. Ya. Translated from Dokl. Akad. Nauk SSSR; 212: No. 1, 67-70(1973). 5p. NTIS.

The report contains an examination of studies of the integral characteristics of plasma near the Moon obtained from instruments on board the Luna-19 station, with the ground receiving station recording the amplitudes and the calculated phase difference of the signals proportional to the integral electron concentration along the communications line. (auth)

13679 THE MOON. International Astronomical Union Symposium Held at Newcastle-upon-Tyne, England, March 22–26, 1971. Runcorn, S. K.; Urey, H. C. (eds.). International Astronomical Union Symposium No. 47. Lawrence, MA; D. Reidel Publishing Company, Inc. (1972). 484p. (CONF-710359-). $35.50.

The symposium covered the following topics: lunar gravitational field; the maria; mechanical processes; Apollo 14; petrological evidence for the evolution of the Moon; evolution of the uppermost regions of the Moon; physical properties; density distribution and thermal state of the Moon's interior; magnetic, electrical, and thermal properties of the interior; evolution of the orbit; Luna 16; and origin of the Moon. (WDM)

13680 FADING OF THERMOLUMINESCENCE INDUCED IN LUNAR FINES. Hwang, F. S. W. (Univ. of Birmingham, Eng.). Nature (London) Phys. Sci.; 245: No. 142, 41-43(17 Sep 1973).

It is stated that rapid fading of thermoluminescence induced in Apollo rock samples has been observed. A significant decay was observed in the third peak of the glow curve when a sample was kept at −196°C after irradiation with 160 MeV protons to 400 kR at this temperature. This fading occurred in only about 2 hr. and was attributed to nonthermal leakage, possibly by "tunnelling" of trapped carriers. The present author has analyzed the trapping parameters of some glow peaks in lunar fines, using both isothermal annealing and "initial rise" techniques, with a view to obtaining a better understanding of their TL properties. The samples were irradiated with either ^{90}Sr β rays or ^{60}Co γ rays at room temperature, and showed the same response to both types

of irradiation. The prominent glow peak at ~155°C consisted of one very unstable and some relatively stable components at room temperature; its isothermal decay was investigated by irradiating the samples with β rays to a standard dose of 1 MR and then keeping it at constant temperature for various times. The curves obtained showed that the decay mode was not a simple exponential decay, as expected for first order kinetics models, and implied that the prominent peak consisted of multiple trapping levels. The isothermal decay curve for a given temperature could be resolved into three components, as in the case of multiple nuclear decay modes. Each component represented the isothermal decay of an individual peak of the corresponding trapping levels, and the half-lives at various temperatures were obtained for each individual peak. Mechanisms are discussed, and it is concluded that the fading at low temperature is temperature dependent, but not by nonthermal "tunnelling" means. This is perhaps due to carriers "hopping out" from shallow surface traps by vibration. (UK)

13681 ELECTRON TEMPERATURE IN THE MARTIAN IONOSPHERE. Shimizu, M.; Ashihara, O. (Tokyo Univ.). Publ. Astron. Soc. Jap.; 24: No. 2, 201-211(Apr 1972).

Electron temperatures in the Martian ionosphere at the times of Mariner 4 and 6 missions were calculated in the continuous slowing-down approximation by using new molecular data. It is concluded that thermal equilibrium between electron and neutral temperatures in the lower part of the ionosphere may exist only when the solar flux recently revised by Hinteregger (1970) is assumed. (auth)

13682 Io-ACCELERATED ELECTRONS: PREDICTIONS FOR PIONEER 10 AND PIONEER 11. Shawhan, S. D.; Gurnett, D. A.; Hubbard, R. F.; Joyce, G. (Univ. of Iowa, Iowa City). Science; 182: No. 4119, 1348-1350(28 Dec 1973).

Based on a model in which electrons are accelerated to energies of 100 kiloelectron volts through sheaths associated with Io, predictions are made about energetic electrons to be observed by Pioneer 10 and Pioneer 11 in the Jovian magnetosphere. This energetic electron source may be distinguishable from the solar-wind diffusion source by the radial flux profile and by the characteristic electron energies. (auth)

PHYSICS (ATMOSPHERIC)

Auroral and Ionospheric Phenomena

Refer also to abstracts 12964, 12965, and 12967.

13683 (BUP-54) PROTON PRECIPITATION AND THE Hβ EMISSION IN A POST-BREAKUP AURORAL GLOW. Soeraas, F.; Lindalen, H. R.; Maseide, K.; Egeland, A.; Evans, D. S. (Bergen Univ. (Norway). Dept. of Physics). Jul 1973. 34p. Dep. NTIS (U. S. Sales Only) $3.75.

Measurements of the hydrogen auroral emissions were made by rocket-borne photometers simultaneously with observations of the energy spectra and pitch angle distributions of the precipitating energetic particles. The rocket was flown through a postbreakup auroral glow known to be associated with proton precipitation on the basis of optical measurements from the ground. The observed Hβ profiles were compared with the profiles derived from the measured primary proton beam and using Eather's (1967) values for the pertinent excitation cross-sections. A good agreement between the measured and computed profiles was obtained. The measured height profiles had the same shape during the ascent and descent parts of the flight, although the absolute intensity of the Hβ emission differed by a factor of two. The maximum volume emission rate was found to be at 112 ± 1 km in both cases while the half-value emission rates were at 107 km and 119 km. The atmospheric density above 120 km altitude had to be reduced by a factor of two as compared with the CIRA 1965 model atmosphere in order to account for the observed energy degradation of the incoming proton beam. (auth)

13684 AIRGLOW HYDROXYL DOUBLET RATIO TEMPERATURES. Harrison, A.W.; Kendall, D.J.W. (Department of Physics, University of Calgary, Calgary, Alberta, Canada). J. Geophys. Res. 78: No. 22, 4697-4701 (1 Aug 1973).

High-resolution spectra of the (4–1) OH band as observed in airglow have been used to examine the relationship between the doublet ratio temperature and the rotational temperatures of each of the $^2\Pi_{1/2}$ and $^2\Pi_{3/2}$ doublet states. For the spectra studied, the two sets of vibration–rotation levels are in Boltzmann equilibrium with one another. (auth)

13685 CONVECTIVE AMPLIFICATION OF TYPE I IRREGULARITIES IN THE EQUATORIAL ELECTROJET. Lee, K.; Kennel, C.F. (Department of Physics and Institute of Geophysics and Planetary Physics, University of California, Los Angeles, California, 90024). J. Geophys. Res. 78: No. 22, 4619-4629 (1 Aug 1973).

Wave propagation and refraction of 'type I' irregularities in the equatorial electrojet are investigated. Quantitative calculation of wave refraction in a model electrojet shows that the direction of wave refraction must change sign at one altitude. Waves propagating with the electrons rotate their wave vectors upward in the upper electrojet and downward in the lower electrojet during the day, and vice versa at night. Furthermore, the altitude region of largest linear growth rate is also the one with the weakest refraction rate. Consequently, computations of the ray-path integrated wave growth show that this region would dominate the backscatter spectrum from the electrojet if linear theory were valid, and it is further noted that the maximum amplitude wave should have phase velocities exceeding the ion acoustic speed. We therefore conclude that propagation alone, without inclusion of nonlinear effects, cannot explain backscatter observations of a constant Doppler frequency shift given by the ion acoustic speed. (auth)

13686 DOPPLER SPECTRA OF DIFFUSE RADAR AURORAS. Ecklund, W.L. (Space Environment Laboratory, National Oceanic and Atmospheric Administration, Boulder, Colorado, 80302); Balsley, B.B.; Greenwald, R.A. J. Geophys. Res. 78: No. 22, 4797-4800 (1 Aug 1973).

Recent data are presented that yield more complete information on the spectral character of the diffuse radar aurora. These data were obtained during October 1971 at Anchorage, Alaska. (WDM)

13687 EFFECT OF AN ISOTROPIC NONEQUILIBRIUM PLASMA ON ELECTRON TEMPERATURE MEASUREMENTS. Benson, R.F.; Hoegy, W.R. (Laboratory for Planetary Atmospheres, NASA Goddard Space Flight Center, Greenbelt, Maryland, 20771). J. Geophys. Res. 78: No. 22, 4702-4706 (1 Aug 1973).

The electron temperatures that would be determined (using the conventional single-temperature analysis) by the electrostatic probe, the diffuse resonance, and the radar backscatter techniques in an isotropic two-temperature plasma are presented. Plasma models corresponding to the addition of a minor component of energetic electrons and models corresponding to a process that cools a fraction of the ionospheric electrons are considered. The diffuse resonance temperature is found to lie between the probe and radar backscatter temperatures. The isotropic models corresponding to the addition of energetic electrons cannot support the reported discrepancies between radio wave and probe electron temperature measurements. Temperature differences similar to the observed differences can be produced by models with a fraction of the electrons at a temperature cooler than that of the main component of electrons. These models, however, are difficult to explain in terms of our present understanding of the ionospheric plasma. (auth)

13688 EQUATORIAL AIRGLOW AND THE IONOSPHERIC GEOMAGNETIC ANOMALY. Chandra, S.; Reed, E.I.; Troy, B.E. Jr. (Laboratory for Planetary Atmospheres, Goddard Space Flight Center, Greenbelt, Maryland, 20771); Blamont, J.E. J. Geophys. Res. 78: No. 22, 4630-4640 (1 Aug 1973).

Ogo 4 observations of the O I (3600-A) emissions have revealed a global pattern hitherto undetected from the ground-based observations. It is seen that the postsunset emission of O I (6300 A) in October 1967 is very asymmetrical with respect to the geomagnetic equator in certain longitude regions and shows poor correlation with the electron density measured simultaneously from the same spacecraft. This asymmetry is less marked in the UV airglow, O I (1356 A), which appears to vary as the square of the maximum electron density in the F region. The horizon scan data of the 6300-A airglow reveal that the latitudinal asymmetry is associated with asymmetry in the height of the O I (6300-A) emission and hence with the altitude of the F_2 peak. From the correlative studies of the airglow and the ionospheric measurements the mechanisms for the UV and the 6300-A emissions are discussed in terms of the process involving radiative and dissociative recombination. Theoretical expressions are developed relating the airglow data to the ionospheric parameters, and it is shown that the agreement between observed and calculated emission rates is well within the uncertainty of the measurements. (auth)

13689 PREDAWN ENHANCEMENT OF 6300-A EMISSION OBSERVED NEAR THE PLASMAPAUSE FROM THE ISIS-2 SPACECRAFT. Shepherd, G.G. (Centre for Research in Experimental Space Science, York University, Toronto, Canada); Brace, L.H.; Whitteker, J.H. J. Geophys. Res. 78: No. 22, 4689-4695 (1 Aug 1973).

Data from several Isis-2 spacecraft passes are described in which the 6300-A atomic oxygen red line photometer mapped intensity steps resembling the predawn enhancement. Comparison with the electron density measured at the spacecraft indicates a plasmapause influence on the 6300-A emission rate, in that the intensity varies roughly inversely with the electron density at 1400 km. A simple calculation demonstrates the idea that field line opacity differences for photoelectrons are significant across the plasmapause. The measured electron temperatures are inadequate to account for the 6300-A excitation, thus confirming that it must arise from another mechanism. (auth)

13690 SEASONAL VARIATION OF AURORAL INFRASONIC WAVE ACTIVITY. Wilson, C.R. (Geophysical Institute, University of Alaska, Fairbanks, Alaska, 99701). J. Geophys. Res. 78: No. 22, 4801-4802 (1 Aug 1973).

Although there has been a large fluctuation in the degree of auroral infrasonic wave (AIW) activity from year to year, it has been possible with 6 years (1966-1972) of data to show that there is a seasonal variation in the number of AIW that is similar to the seasonal variation found for auroral activity. (WDM)

13691 SPREAD E CAUSED BY CROSS-FIELD INSTABILITY. Chen, A.A. (University of the West Indies, Mona, Jamaica). J. Geophys. Res. 78: No. 22, 4707-4709 (1 Aug 1973).

Analysis of spread E, the spreading frequently observed above the sporadic E layer, shows that it can be caused by the cross-field plasma instability mechanism proposed by Reid [1968] and Chen et al. [1972]. The analysis was based on the determination of the extent of spreading relative to the blanketing frequency of the sporadic E layer, and the results of the analysis were such that they conformed with predictions based on the cross-field instability mechanism. (auth)

13692 ULTRAVIOLET OBSERVATIONS OF EQUATORIAL DAYGLOW ABOVE THE F_2 PEAK. Boksenberg, A. (Department of Physics and Astronomy, University College, London, England); Gérard, J. J. Geophys. Res. 78: No. 22, 4641-4650 (1 Aug 1973).

Ultraviolet emissions above 540 km have been detected in the equatorial zone at a local time near 1800 with instruments aboard the TD1 A astronomical satellite. The main features of the emissions can be accounted for by resonance scattering of sunlight by Mg^+ ions. The observations confirm previous mass spectrometric measurements of metallic ions in the equatorial ionosphere and generally are consistent with the vertical transport mechanism proposed by Hanson and others. The emissions often are highly asymmetrical with respect to the

magnetic dip equator, possibly indicating the effect of transequatorial neutral winds. Additional weaker equatorial emissions have been tentatively identified with Fe^+, O^+, and possibly Si^+ ions geographically distinct from the Mg^+ ions. (auth)

13693 ATMOSPHERIC EXPANSION THROUGH JOULE HEATING BY HORIZONTAL ELECTRIC FIELDS. Bates, H. F. (Univ. of Alaska, College). Planet. Space Sci.; 21: No. 12, 2073-2088(Dec 1973).

Incoherent scatter measurements made along a magnetic field line into aurora during a period of high electric field in the recovery phase of a substorm show (1) considerably increased electron densities well above the normal F-region maximum, and (2) field-aligned plasma drifts that increase with altitude. A model invoking atmospheric expansion through Joule heating by the horizontal electric field driving the auroral electrojet is used to explain the observations. From this study it is concluded that during magnetically disturbed periods (1) Joule heating by the auroral electrojet raises the neutral temperature and density in the auroral zone ionosphere at F-region heights, (2) ionization formed by the aurora is transported upward by the expanding atmosphere, at times producing an appreciable increase in lower exospheric plasma densities on the field lines containing the aurora, and (3) combined satellite, radar, and optical observations during periods of aurora and high electric field could provide measured F-region collision frequencies. (auth)

13694 IONOSPHERIC ELECTRIC FIELD AND CURRENT DISTRIBUTION ASSOCIATED WITH HIGH ALTITUDE ELECTRIC FIELD INHOMOGENEITIES. Lennartsson, O. W. (Kungliga Tekniska Hoegskolan, Stockholm). Planet. Space Sci.; 21: No. 12, 2089-2112(Dec 1973).

A quantitative theoretical analysis of electric field and current distributions in the ionosphere is given assuming certain time variable convection field profiles at an altitude of 1250 km. A number of idealized assumptions regarding the ionospheric characteristics are defined and discussed. A qualitative discussion of a quasi-stationary configuration with an approximately curl free electric field is also given. Geomagnetic field aligned current densities $i_{||}$ of the order 10^{-5} to 10^{-4} A/m^2 are consistent with quite reasonable assumptions about the convection field $E_\perp$. Oscillations in $E_\perp$ with periods of the order of 10 sec should readily be generated when $\sigma_{||}$ is large. In the quasi-stationary case there may be a mechanism that strengthens and concentrates $i_{||}$ locally under certain conditions. It is found that a number of recent high-altitude observations of convection field reversals may be consistent with large potential drops along the magnetic field lines. The solutions obtained as well as some of the basic assumptions are compared with observations. (auth)

13695 EFFECTS OF E-REGION ELECTRIC FIELDS ON F-REGION PARAMETERS AT THE MAGNETIC EQUATOR. Gupta, K. S.; Murthy, B. V. K. (Vikram Sarabhai Space Centre, Trivandrum, India). Planet. Space Sci.; 21: No. 12, 2227-2232(Dec 1973).

The effects of E-region electric fields on F-region parameters like height of constant electron density contours (h_N) and semi-thickness, at an equatorial station, Trivandrum, are investigated. The E-region east–west electric field (E_y) has been deduced using the horizontal magnetic field values from the ground magnetograms. It is found that the semi-thickness parameter and h_N follow closely the E-region electric field (E_y) variations in the forenoon and noon periods. In the afternoon, it is shown that there is close association between h_N and E_y when the electric field variations are large. On a day-to-day basis also, h_N and the E-region electric field show very good correlation in the forenoon and noon hours. It is also shown that higher levels are affected more than the lower levels in the F-region by E_y. (auth)

13696 NONLINEAR RESONANT EXCITATION OF WHISTLER MODE WAVES IN THE EARTH'S IONOSPHERE USING TWO HIGH FREQUENCY TRANSMITTERS. Martelli, G.; Giles, M. J.; Christiansen, P. (Univ. of Sussex, Brighton, Eng.). Planet. Space Sci.; 21: No. 12, 2113-2121(Dec 1973).

The possibility of exciting whistler mode waves (WMWs) in the Earth's ionosphere, by using two high-frequency beams of electromagnetic waves ($f_1 \sim f_2$) suitably orientated to the geomagnetic field H_0, so that a nonlinear resonant interaction can take place in the natural ionospheric plasma, approximately at the altitude of the F2 maximum electron density is discussed. Within the limitations imposed by ionospheric inhomogeneities in the interaction region, it should be possible to excite a WMW which propagates along a predetermined direction, e.g., parallel to H_0. If it is assumed that f_1 and f_2 are approx 30 MHz (i.e., well above the ionospheric plasma frequency), this method would make it possible to select and vary the frequency range of the excited WMW up to a few hundreds kHz without substantial alterations to the high frequency transmitting system. Since the two beams should form an angle close to 90° to the direction of propagation of the WMW, this technique may prove particularly suitable for active wave experiments at low geomagnetic latitudes, where the geometry of the geomagnetic field limits the feasibility of direct wave injection experiments. Using the results of theoretical calculations of the three wave coupling coefficients, it is shown that the transmitters required to produce WMWs with field strengths comparable to that of naturally occurring strong whistlers are substantial, but feasible. (auth)

13697 PROPAGATION OF HYDROMAGNETIC WAVES IN THE UPPER F2-REGION. Hung, R. J.; Wu, S. T.; Smith, R. E. (Univ. of Alabama, Huntsville). Planet. Space Sci.; 21: No. 12, 2157-2171(Dec 1973).

The theory of hydromagnetic-waves in the upper F2-region, in which electrons are in a transitional regime from collisional to collisionless conditions and ions are in a collisionless state, is examined. Derivation of the governing equations is based on the fact that the isotropic electrons are fluid-like, and the anisotropic ions follow kinetic equations modified by ion–electron collisions. Magneto-acoustic waves of a period of ~0.2 to 10 sec are dissipated by ion Landau damping and electron thermal conduction and viscosity. Numerical solutions under ionospheric conditions show that the dissipation of hydromagnetic waves is insufficient to modify the large scale heating of the ionosphere. (auth)

13698 LARGE-SCALE AURORAL-ZONE ELECTRON PRECIPITATION EVENT, BRIEFLY INTERRUPTED DURING A NEGATIVE MAGNETIC IMPULSE. Pytte, T.; Bjordal, J.; Broenstad, K.; Singstad, I.; Stadsnes, J.; Trefall, H.; Ullaland, S.; Brown, R. R.; Karas, R. H. (Univ., Bergen). J. Atmos. Terrest. Phys.; 36: No. 1, 29-42(Jan 1974).

Multiple balloon recordings of bremsstrahlung x rays from a large scale auroral-zone electron precipitation event are presented. Additional riometer recordings show that it extended from noon, via dusk, to midnight. The x-ray observations show electron precipitation over a range of L-values from ≃ 5.5 to 7.5. This was briefly interrupted during a negative sudden impulse in the geomagnetic field. A close similarity between variations in the x-ray fluxes and locally recorded variations in the geomagnetic field was observed. Magnetic records from around the auroral zone suggest that the precipitation was related to an asymmetric magnetospheric convection system. (auth)

13699 POWER SPECTRA OF IONOSPHERIC SCINTILLATIONS. Singleton, D. G. (Air Force Cambridge Research Labs., Bedford, MA). J. Atmos. Terrest. Phys.; 36: No. 1, 113-133 (Jan 1974).

The diffraction theory of interplanetary scintillations, which allows a connection to be established between the spatial spectrum of electron-density fluctuations in the irregular medium and the power spectrum of intensity scintillations observed on the ground, is reviewed and applied to the case of the ionosphere. Expressions are found for the Fourier and Bessel spectra of the intensity scintillations for both Gaussian and power-law ionospheric irregularities. These are employed to interpret experimental Fourier and Bessel spectra observed at Hamilton, Massachusetts. It is found that 80 per cent of the Bessel spectra but only 10 per cent of the Fourier spectra are modulated in the way predicated by the theory for various diffraction pattern configurations. This leads to the conclusion that the diffraction pattern on the ground is only slightly anisotropic, the extent of the anisotropy being larger to the north at low elevations than overhead. Further, it is shown that this result is consistent with the interpretation of recent scintillation index observations in terms of irregularities which are elongated along the magnetic field and, to a lesser extent, normal to the magnetic-meridian plane. The scintillation spectra are also consistent with a spatial spectrum of electron-density fluctuations in the ionosphere which is power law rather than Gaussian in form. The implication of this failure of the Gaussian form to diffraction theory is discussed briefly. (auth)

13700 MOVEMENT PROCESSES OF AURORAL STRUCTURES. Czechowsky, P. (Max-Planck-Institut fuer Aeronomie, Lindau, Ger.). J. Atmos. Terrest. Phys.; 36: No. 1, 61-77(Jan 1974).

The analysis of backscatter signals recorded during the observation of radio auroras on February 23 and 24/25, 1971 at the receiving station Lycksele (Sweden) and the comparison of these data with values derived from parameters of the disturbed polar E-layer show, that the measured Doppler shift f of backscatter echoes is caused by the movements of field-aligned column-like inhomogeneities. Furthermore at the same time the condition which leads to the excitation of wave-type electron density inhomogeneities was fulfilled, but the angular interval in which these density waves can propagate was too small to explain

a scatter process of radio waves in the direction parallel to the antenna of the receiving station Lycksele. (auth)

13701 LUNAR EFFECTS IN THE COUNTER ELECTROJET NEAR THE MAGNETIC EQUATOR. Rastogi, R. G. (Physical Research Lab., Ahmedabad, India). J. Atmos. Terrest. Phys.; 36: No. 1, 167-170(Jan 1974).

The examination of H magnetograms of Huancayo for the period, 1948 to 1971, has shown that the negative effects on the daily variation of H occur primarily in the morning hours around 07 hr and in the evening between 15 and 17 hr. The occurrence of the evening event is maximum around lunar ages 1.4 and 13.4 hr or around lunar times 2.2 and 14.2 hr. The occurrence of the morning events is maximum around lunar ages 4.8 and 16.8 hr or around lunar times 2.3 and 14.3 hr. These lunar times correspond to that of maximum negative effect in H due to lunar tidal wave. These counter electrojet effects are suggested to be due to the superposition of lunar semi-diurnal wave over the solar daily wave of H. The late appearance of sporadic-E in the morning or the earlier disappearance of E_s in the evening is due to these counter electrojet events, when the ionospheric currents over the equatorial regions are reversed to westward direction during the daylight hours. (auth)

13702 DIFFUSION-RECOMBINATIONAL MECHANISM OF THE FORMATION OF THE IONIZED LAYER IN THE F_2 REGION OF THE IONOSPHERE. Khantadze, A. G. (Inst. of Geophysics, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 72: No. 3, 561-563(Dec 1973). (In Russian).

By means of the solution of the stationary diffusion equation, taking into account the recombinational mechanism, it is analytically shown that in the F2 layer of the ionosphere the distribution of the charged particles with height conforms to the Chapman-type distribution. (auth)

13703 OGO 6 MEASUREMENTS OF SUPERCOOLED PLASMA IN THE EQUATORIAL EXOSPHERE. Hanson, W. B. (Univ. of Texas, Dallas); Nagy, A. F.; Moffett, R. J. J. Geophys. Res.; 78: No. 4, 751-756(1 Feb 1973).

Plasma measurements performed on Ogo 6 reveal T_e and T_i values that on occasion appear to be well below the expected neutral gas temperature. The phenomenon is observed only at night above 500 km near the magnetic equator. It is suggested that the expansion cooling of the plasma is accomplished by downward motions of the F-region plasma induced by winds or diffusion, by outward $E \times B$ drift, or more probably by the upward flow of plasma during interhemisphere transport along magnetic field lines. In the last case, energy gained by the supercooled upward flowing plasma by thermal conduction will increase its potential temperature, so that the same gas will be superheated on returning to its initial altitude in the opposite hemisphere. It is also suggested that preferential cooling of electrons because of their greater thermal conductivity should tend to give $T_i > T_e$ during the postsunset cooling of the plasmasphere when photoelectrons are absent. (auth)

13704 SOLAR LYMAN ALPHA CHANGES AND RELATED HYDROGEN DENSITY DISTRIBUTION AT THE EARTH'S EXOBASE (1969-1970). Vidal-Madjar, A. (CNRS, Verrieres-le-Buisson, France); Blamont, J. E.; Phissamay, B. J. Geophys. Res.; 78: No. 7, 1115-1141(1 Mar 1973).

The University of Paris experiment, operating on board the OSO 5 spacecraft since January 22, 1969, observes the solar Lyman α line integrated over the whole solar disk. The hydrogen and deuterium resonance cells yield information about the solar flux at the center of the line and on the blue wing. The center of the solar line as observed from the spacecraft is strongly absorbed by the Earth's geocorona. Therefore the hydrogen resonance data contain solar, as well as geocoronal, information. Comparison of the data with sophisticated exospheric models gives the following principal results: (1) A high correlation (0.87 coefficient) exists between the total Lyman α line flux and the center line flux. A 30% variation in the total flux corresponds to a 47% variation in the central flux. The average fluxes over 1969 and 1970 are 3×10^{11} ph cm^{-2} sec^{-1} total flux and 5×10^{11} ph cm^{-2} sec^{-1} A^{-1} central flux. (2) The absolute value of the hydrogen density at 500-km altitude (independent of the experiment's calibration) is of the order of 5×10^4 atoms cm^{-3} on the day side and 9×10^4 atoms cm^{-3} on the night side. (3) The Earth's hydrogen exobase is controlled by the zero net ballistic flux condition (i.e., the outgoing ballistic flux is everywhere equal to the incoming ballistic flux). This is why an average ratio of 1.7 was found between the maximum and minimum densities at the exobase. A discrepancy appeared between the absolute values of the hydrogen density measured by this experiment and the corresponding absolute values predicted by the model of Kockarts and Nicolet (1963). In order to fit the data, the values of the model should be increased to the following hydrogen densities at an altitude of 100 km: 2.3×10^7 atoms cm^{-3} for low solar activity (Zurich number Rz ~ 60); 2.5×10^7 atoms cm^{-3} for mean solar activity (Rz ~ 120); and 4×10^7 atoms cm^{-3} for high solar activity (Rz ~ 180). (auth)

Magnetospheric Phenomena

Refer also to abstract 13542.

13705 DOUBLE FLOATING PROBE MEASUREMENTS ON S^3-A. Maynard, N.C.; Cauffman, D.P. (Goddard Space Flight Center, Greenbelt, Maryland, 20771). J. Geophys. Res. 78: No. 22, 4745-4750 (1 Aug 1973).

Explorer 45 carried a pair of symmetrical floating probes designed to measure d-c electric fields in regions well inside the plasmapause. The purpose of this letter is to introduce results from model calculations made to explain the observed probe potential behavior; to use these and comparisons with vlf data to establish that certain effects seen are interpretable as the plasmapause; and to present the behavior of the plasmapause during and around the Dec. 17, 1971 magnetic storm using the double-probe data. (WDM)

13706 DYNAMIC VARIATIONS IN INTENSITY AND ENERGY SPECTRA OF ELECTRONS IN THE INNER RADIATION BELT. Imhof, W.L.; Gaines, E.E.; Reagan, J.B. (Lockheed Palo Alto Research Laboratory, Palo Alto, California, 94304). J. Geophys. Res. 78: No. 22, 4568-4577 (1 Aug 1973).

The energy spectra and intensities of electrons >130 kev have been measured since October 1971 with two 256-channel electron spectrometers on board the low-altitude (~800-km) polar-orbiting earth-oriented satellite 1971 089A. In the inner radiation belt the energy spectra of the trapped electrons can often be characterized as exponential in shape, but during magnetic disturbances the trapped fluxes at the lower edge of the inner belt ($L \lesssim 1.3$) may be quite variable and may extend to lower L values, and the energy spectra may display pronounced structure, such as the presence of one or more peaks. Several features of the data are in agreement with a set of observations made at a time when the Starfish electrons were dominant and are consistent with the origin of the peaks being a redistribution of the existing population. Peaks in the energy spectra are also frequently observed at the outer edge of the inner belt ($L \approx 1.4 - 1.8$), but several features of these peaks are in distinct contrast to those observed on very low L shells. The energies of the peaks seen in the outer parts of the belt usually decrease very rapidly with increasing L value, whereas the energies of those seen at the lower edge of the belt are generally not strongly dependent upon L. At $L \approx 1.4$ to 1.8 the most pronounced peaks occur more often at low h_{min} values; in contrast, structure in the spectra seen at the inner edge of the belt is usually more pronounced at higher values of h_{min}. These and other differing characteristics suggest that the peaks in the outer portions of the belt are associated with precipitation processes and do not result from the same type of 'redistribution in L' mechanism proposed for the nearly monoenergetic spectra sometimes seen at the lower edge of the inner belt. The observations suggest that peaks may originate from a cyclotron resonance interaction of electrons with whistlers of a nearly constant frequency over the L range of concern. (auth)

13707 ELF OBSERVATIONS DURING THE DECEMBER 1971 STORM. Parady, B.; Cahill, L.J. Jr. (School of Physics and Astronomy and Space Science Center, University of Minnesota, Minneapolis, Minnesota, 55455). J. Geophys. Res. 78: No. 22, 4765-4770 (1 Aug 1973).

Initial results from the University of Minnesota search coil magnetometers abroad Explorer 45 show several types of elf signals during the magnetic storms of December 16-19, 1971. The orbit of the satellite at this time was nearly equatorial, with an apogee near 5 R_E at 2100 local time, and a perigee below 300 km. The emissions vary during different phases of the storms and also with the position of the spacecraft in the magnetosphere. The location of the plasmapause appears to be a particularly important factor in determining the type and intensity of the signals. (auth)

13708 ENERGY SPECTRA AND PITCH ANGLE DISTRIBUTIONS OF STORM-TIME AND SUBSTORM INJECTED PROTONS. Konradi, A. (NASA Manned Spacecraft Center, Houston, Texas, 77058); Williams, D.J.; Fritz, T.A. J. Geophys. Res. 78: No. 22, 4739-4744 (1 Aug 1973).

Some of the initial observations made with the solid-state proton detector on Explorer 45 are discussed. Descriptions are given of (1) the energy spectra and pitch angle distributions of ring current protons observed during the main and fast recovery phases of the Dec. 17, 1971 storm; and (2) appearances of characteristic changes in the pitch angle distributions of ~100-

keV protons, which are interpreted as pitch angle dispersion of rapidly injected protons induced by their azimuthal drift at L values above 5. (WDM)

13709 INITIAL OBSERVATIONS OF GEOMAGNETICALLY TRAPPED ALPHA PARTICLES AT THE EQUATOR. Fritz, T.A.; Williams, D.J. (NOAA, Space Environment Laboratory, Boulder, Colorado, 80302). J. Geophys. Res. 78: No. 22, 4719-4723 (1 Aug 1973).

The first observations of alpha-particle fluxes and pitch angle distributions at high altitudes ($3.1 \leq L \leq 5.2$) near the geomagnetic equatorial plane are reported. (WDM)

13710 MAGNETIC STORM INFLATION IN THE EVENING SECTOR. Cahill, L.J. Jr. (School of Physics and Astronomy and Space Science Center, University of Minnesota, Minneapolis, Minnesota, 55455). J. Geophys. Res. 78: No. 22, 4724-4730 (1 Aug 1973).

Previous studies have indicated that the development of magnetic storms commences with an asymmetric inflation of the magnetosphere in the evening and afternoon sectors due to entry there of protons into the closed field lines from L = 7 to L = 3. The Explorer 45 satellite was launched into the evening quadrant in November 1971 to investigate further, with an expanded inventory of field and particle observations, the development and subsequent stages of magnetic storms. In December 1971, there was, conveniently, a double magnetic storm; ground records are shown. The two periods of magnetic disturbance are quite different in appearance. In this note the reasons for the difference is examined, by employing the time sequence of inflation of the evening quadrant revealed by the satellite and ground level magnetic observations. (WDM)

13711 OBSERVATIONS OF PROTON SPECTRA ($1.0 \leq E_p \leq 300$ kev) AND FLUXES AT THE PLASMAPAUSE. Williams, D.J.; Fritz, T.A. (Space Environment Laboratory, NOAA/ERL, Boulder, Colorado, 80302). J. Geophys. Res. 78: No. 22, 4751-4755 (1 Aug 1973).

Detailed proton spectral and pitch angle distribution observation were obtained from instrumentation flown aboard Explorer 45. Data used in this initial report are from two proton detectors and a three-axis fluxgate magnetometer. Orbit 99 inbound occurring on Dec. 17, some 8 hours before the sudden commencement of a magnetic storm, is considered. (WDM)

13712 PARTICLE AND FIELD OBSERVATIONS FROM EXPLORER 45 DURING THE DECEMBER 1971 MAGNETIC STORM PERIOD. Hoffman, R.A. (NASA Goddard Space Flight Center, Greenbelt, Maryland, 20771). J. Geophys. Res. 78: No. 22, 4771-4777 (1 Aug 1973).

Simultaneous observations from Explorer 45 of the magnetic signature of the ring current and complete measurements of the proton ring current to distances of 5.24 R_E during the double magnetic storm of December 16-19, 1971 are presented. Magnetic records from low-latitude and auroral magnetic observatories for this period have already been presented [Cahill, 1973]. (WDM)

13713 PLASMA WAVE OBSERVATIONS NEAR THE PLASMAPAUSE WITH THE S^3-A SATELLITE. Anderson, R.R.; Gurnett, D.A. (Department of Physics and Astronomy, The University of Iowa, Iowa City, Iowa, 52240). J. Geophys. Res. 78: No. 22, 4756-4764 (1 Aug 1973).

The electric field noise phenomena observed by the S^3-A spacecraft near the plasmapause during the magnetic storm of December 16-17, 1971 are described. The most striking and unusual feature of these storm time electric field observations is the occurrence of a region of intense low-frequency (20 to 500 Hz) electrostatic noise bursts just outside the plasmapause boundary. These noise bursts occurred concurrent with the rapid decrease in low-energy ($20 \lesssim E \lesssim 50$ keV) ring current protons mirroring near the equator during this storm and may be responsible for the loss of these particles. The characteristics of other phenomena, such as whistlers, elf hiss, and banded chorus, observed near the plasmapause during this period are also discussed. (auth)

13714 RING CURRENT PARTICLE DISTRIBUTIONS DURING THE MAGNETIC STORMS OF DECEMBER 16-18, 1971. Smith, P.H.; Hoffman, R.A. (NASA Goddard Space Flight Center, Greenbelt, Maryland, 20771). J. Geophys. Res. 78: No. 22, 4731-4737 (1 Aug 1973).

Results are presented which were derived from proton data taken during the magnetic storms of Dec. 16-18, 1971. Both storms initiated with a sudden commencement and positive phase, but the main phase of the first storm did not fully develop. The proton energy density distributions during the storms are considered and the development of the ring current for the two events is constrasted. (WDM)

13715 THE SOURCE OF INNER BELT PROTONS. Claflin, E.S.; White, R.S. (Physics Department and Institute of Geophysics and Planetary Physics, University of California, Riverside, California, 92502). J. Geophys. Res. 78: No. 22, 4675-4678 (1 Aug 1973).

The inner-belt equilibrium equatorial proton flux is calculated by using the recent UCR albedo neutron measurements as a source. The effects of atmospheric collisions, radial diffusion, and the secular decrease of the earth's magnetic field are included, following closely the theoretical work of Farley and Walt. The results are compared with the measured proton fluxes of Thede and of Hovestadt et al. The calculated fluxes are in agreement with the Hovestadt data at all μ (≥ 200 Mev/gauss) and at all L ($1.18 \leq L \leq 1.6$) when the solar maximum atmosphere is used. When the solar cycle average atmosphere is used, the values agree to within a factor of 2.5 for $L \geq 1.25$. By assuming a trapped proton flux of zero at L=4.0, it is shown that all radiation belt protons above about 30 Mev can be supplied by albedo neutron decay, independent of any other source. (auth)

13716 ULF GEOMAGNETIC POWER NEAR L = 4, 2. TEMPORAL VARIATION OF THE RADIAL DIFFUSION COEFFICIENT FOR RELATIVISTIC ELECTRONS. Lanzerotti, L.J.; Morgan, C.G. (Bell Laboratories, Murray Hill, New Jersey, 07974). J. Geophys. Res. 78: No. 22, 4600-4610 (1 Aug 1973).

Measurements at conjugate points on the ground near L=4 of the power spectra of magnetic-field fluctuations in the frequency range 0.5 to 20 mHz are used as a means of estimating daily values for the relativistic-electron radial-diffusion coefficient D_{LL} for two periods in December 1971 and January 1972. The values deduced for $L^{-10}D_{LL}$ show a strong variation with magnetic activity, as measured by the Fredericksburg magnetic index K_{FR}. When $K_{FR} \lesssim 2$, it is generally found that $D_{LL} \lesssim 2 \times 10^{-9} L^{10}$ day^{-1} for equatorially mirroring electrons having a first invariant M=750 Mev/gauss; a value of $D_{LL} \approx 4 \times 10^{-7} L^{10}$ day^{-1} is deduced for one day on which the mean K_{FR} was 4.5. The quantity $L^{-10}D_{LL}$ theoretically depends on energy and L as $(L/M)^{(s-2)/2}$ for relativistic particles, where s is the logarithmic slope of the power-law spectrum of magnetic fluctuations observed on the ground. For the time period analyzed, s typically had values between 1 and 3. (auth)

13717 K_p INDEX CORRELATIONS WITH SOLAR-WIND PARAMETERS DURING THE FIRST AND SECOND STAGES OF A RECURRENT GEOMAGNETIC STORM. Bobrov, M. S. Planet. Space Sci.; 21: No. 12, 2139-2147(Dec 1973).

The dependence of geomagnetic activity during a recurrent magnetic storm on the solar-wind magnetic field and plasma parameters has been studied. According to variations of solar-wind magnetic field strength B, a recurrent magnetic storm is divided into two stages: the first proceeding during the peak of B, and the second proceeding after the return of B to quiet level. The K_p index vs solar-wind parameters scattering diagrams for stages I and II differ significantly. In particular, the random scattering for stage I is much larger than for stage II. It was found that for stage I the K_p index correlates with B, with the sign and value of north-south field component B_z and with the magnitude ΔB of field fluctuations, the situation being similar to that during sporadic magnetic storms, though the scale of the event is smaller. For stage II, the K_p index does not correlate with B, but strongly correlates with ΔB and weaker—with B_z. So geomagnetic activity at stage II is supported mainly by solar-wind magnetic field fluctuations. The dependence of the K_p index on plasma parameters (concentration of protons n, bulk velocity v and temperature T) is weak for both stages. (auth)

13718 REFLECTION AND REFRACTION OF HYDROMAGNETIC WAVES AT THE MAGNETOPAUSE. Verzariu, P. (Hopkins Univ., Silver Spring, MD). Planet. Space Sci.; 21: No. 12, 2213-2225(Dec 1973).

Reflection and transmission coefficients of MHD waves are obtained at a stable, plane interface which separates two compressible, perfectly conducting media in relative motion to each other. The coefficients are evaluated for representative conditions of the quiet-time, near-Earth magnetopause. The transmission coefficient averaged over a hemispherical distribution of incident waves is found to be 1 to 2 per cent. Yet the magnitude of the energy flux deposited into the magnetosphere in a day averaged over a hemispherical distribution of waves having amplitudes of say 2 to 3 gamma, is estimated to be of the order 10^{22} erg. Therefore the energy input of MHD waves must contribute significantly to the energy budget of the magnetosphere. The assumption that the boundary surface is a tangential discontinuity with no curvature limits the present theory to hydromagnetic frequencies higher than about 10^{-1} Hz. The ion gyrofrequencies for the models assumed here lie above $\sim 2 \times 10^{-1}$ Hz. Therefore the present treatment applies to MHD waves near 10^{-1} Hz. (auth)

13719 CROSS-CORRELATION ANALYSIS OF THE AE INDEX AND THE INTERPLANETARY MAGNETIC FIELD B_z COMPONENT. Meng, C. I. (Univ. of California, Berkeley); Tsuru-

tani, B.; Kawasaki, K.; Akasofu, S. I. J. Geophys. Res.; 78: No. 4, 617-629(1 Feb 1973).

A cross-correlation study between magnetospheric activity (the AE index) and the southward-directed component of the interplanetary magnetic field (IMF) is made for a total of 792 hours (33 days) with a time resolution of about 5.5 min. The peak correlation tends to occur when the interplanetary data are shifted approximately 40 min later with respect to the AE index data. Cross-correlation analysis is conducted on some idealized wave forms to illustrate that this delay between southward turning of the IMF and the AE index should not be interpreted as being the duration of the growth phase. (auth)

13720 USE OF ELECTRON AND PROTON BEAMS FOR PRODUCTION OF VERY LOW FREQUENCY AND HYDROMAGNETIC EMISSIONS. Dowden, R. L. (Univ. of Otago, Dunedin, New Zealand). J. Geophys. Res.; 78: No. 4, 684-696(1 Feb 1973).

The feasibility of using helical partical beams (~10 keV, 1 A) fired from orbiting satellites to produce backward Doppler-shifted cyclotron emission (very low-frequency from electrons, hydromagnetic or micropulsations from protons) is considered. It is found that the frequency and position of emission can be controlled by choice of particle energy and by gyrophase modulation (or "rotation") of the beams at the desired frequency. Phase spread of the pre-phased beams through both natural processes and limitations of accelerators, as well as through radiative instability of the beams, should not be serious. Emitted powers of tens of watts are expected. (auth)

13721 ELECTRIC FIELD AND WIND MOTION AT THE MAGNETIC EQUATOR. Kato, S. (Kyoto Univ.). J. Geophys. Res.; 78: No. 4, 757-762(1 Feb 1973).

The vertical electric field due to charge separation is calculated for a horizontal wind motion periodic with height, latitude, and longitude under magnetical equatorial conditions. It is found that the electric field is less than $(W \times B_0)$ in magnitude at the magnetic equator in the presence of the curved lines of force of geomagnetic field B_0, where W is the wind velocity. Thus the $(W \times B_0)$ field at the equator directly contributes to driving the equatorial electrojet; the driving electric field is not curl free. The wind shear mechanism for producing ionization irregularities is still effective at the equator, but of lower efficiency than at mid-latitudes. Certain observations are consistent with the present conclusion. (auth)

13722 INDIRECT METHOD FOR MEASURING EQUATORIAL ELECTROJET CURRENTS AND ITS RELATION TO NONLINEAR SATURATION OF TYPE I INSTABILITIES. Weinstock, J. (National Oceanic and Atmospheric Administration, Boulder, CO). J. Geophys. Res.; 78: No. 4, 772-773(1 Feb 1973).

In view of the crucial importance of an accurate knowledge of the peak value of the electrojet drift speed, v_p, for any theory of type I irregularities, it would be useful to have an independent method of specifically measuring the peak of v_p. This letter points out that such a method exists and has been largely overlooked. (WDM)

PHYSICS (ATOMIC AND MOLECULAR)

Beams and Their Reactions

13723 (ANL-7996, pp 50-57) MOLECULAR-BEAM STUDIES. Wexler, S.; Parks, E. K.; Young, C. E.; Pobo, L. G. Feb 1973.

In chemistry division annual report, July 1971–June 1972.

The design and performance of aerodynamic, sputtering, and ion acceleration–neutralization chemical accelerators are described for molecular beams. (JFP)

13724 INSTABILITY OF AN UNNEUTRALIZED RELATIVISTIC ELECTRON BEAM. Carmel, Y.; Nation, J.A. (Laboratory of Plasma Studies and School of Electrical Engineering, Cornell University, Ithaca, New York, 14850). Phys. Rev. Lett. 31: No. 5, 286-289 (30 July 1973).

Experimental observations of the propagation of an intense, unneutralized, annular, relativistic electron beam along a homogeneous magnetic guide field show that it is unstable. The instability is accompanied by a loss of beam particles and intense microwave emission. (auth)

13725 ELECTRON BEAM CONCENTRATION ENHANCED BY A LASER-PRODUCED PLASMA. Miller, P.A.; Chang, J.; Kuswa, G.W. (Sandia Laboratories, Albuquerque, New Mexico 87115). Appl. Phys. Lett. 23: No. 8, 423-425 (15 Oct 1973).

A new technique has been developed for the production of tightly focused intense relativistic electron beams. A collimated plume of laser blowoff plasma is injected on axis into the anode-cathode gap region of a low-impedance diode prior to the beam pulse. The electron beam is found to pinch in the diode to current densities ≥ 2 MA/cm^2. (auth)

13726 LIMITING CURRENTS IN UNNEUTRALIZED RELATIVISTIC ELECTRON BEAMS. Nation, J.A.; Read, M. (Laboratory of Plasma Studies and School of Electrical Engineering, Cornell University, Ithaca, New York 14850). Appl. Phys. Lett. 23: No. 8, 426-428 (15 Oct 1973).

The space-charge depression of the potential within an unneutralized relativistic electron beam limits the beam current. Calculations of this effect are presented for an annular beam and compared to experiment. (auth)

13727 ION SOURCE WITH REDUCED EMITTANCE. Ormrod, J. H. (to Atomic Energy of Canada Ltd.). US Patent 3,767,952. 23 Oct 1973. Filed date 24 Oct 1972. 4p.

An ion source modified by an additional electrode, designed as a scraper electrode, positioned between the anode and extractor electrode, having an aperture slightly less than the source plasma aperture, and adapted to carry a pre-determined voltage in reference to the anode is described. It was found that the scraper electrode intercepts and removes ions at the periphery of the beam cross-sectional area and this is the region that contains ions that contribute most greatly to the increased emittance. The central, nonintercepted cross-sectional area therefore has a much reduced emittance. The voltage on the scraper electrode should be such as to not disturb or distract the electric field between anode and extractor electrode. (Official Gazette)

Atomic and Molecular Properties

Refer also to abstracts 13353, 13748, 13787–13790, and 13806.

13728 COHERENT EXCITATION OF S AND P STATES OF THE n=2 TERM OF ATOMIC HYDROGEN. Eck, T.G. (Department of Physics, Case Western University, Cleveland, Ohio, 44106). Phys. Rev. Lett. 31: No. 5, 270-273 (30 July 1973).

An expression is given for the Stark-induced beat signal in the Lyman-α radiation from hydrogen atoms in a beam-foil experiment. This expression includes possible contributions to the beat signal from coherent excitation of S and P states in the beam-foil process. For the case where the electric field is applied parallel to the beam, the coherent-excitation contributions can be separated experimentally from those resulting purely from coherence produced by the electric field, by simply reversing the direction of the electric field. (auth)

13729 SPECTRUM OF PLASMA OSCILLATIONS IN ATOMS. Sen, A. (Physical Research Lab., Ahmedabad, India). Lett. Nuovo Cim.; 8: No. 12, 749-752(17 Nov 1973).

A microscopic approach to the problem of collective oscillations of electrons in heavy atoms is considered by treating the atomic electrons as a plasma in an inhomogeneous field and thus considering an appropriate integral equation for its self-consistent potential. An attempt is made to obtain realistic numerical estimates of the eigenfrequencies without resort to any specific statistical model of the atom. The results are presented for two different modes—the spherically symmetric mode and the mode with a cos Θ angular dependence. (LBS)

13730 ONE-ELECTRON SPECTRUM OF SINGLY IONIZED YTTERBIUM (Yb II). Kaufman, V.; Sugar, J. (National Bureau of Standards, Washington, D. C. 20234). J. Opt. Soc. Am. 63: No. 9, 1168-1172 (Sept 1973).

The spectrum produced by the hollow-cathode discharge was measured from 2107 to 1377 Å. With these new data and the previously published observations of Yb II at longer wavelengths, new $4f^{14}nl$ series terms were found, including 10s, 7p, 7–11d, 5–14f, and 5–6g. A value of 98269(50) cm^{-1} was deduced for the ionization energy. Index Headings: Ytterbium; Spectra; Wavelengths. (auth)

13731 THEORETICAL CONSIDERATION OF THE ENERGY LEVELS OF THE HYDROGEN ATOM UNDER THE LOW COMPRESSION. Kalade, Yu. A.; Savukinas, A. Yu. (Inst. of Physics and Mathematics, Vilnyus, USSR). Liet. Fiz. Rinkinys; 13: No. 4, 489-494(1973). (In Russian).

The energy level shift of the compressed hydrogen atom and hydrogen-like ions by imposing the boundary condition for the radial orbitals R (r_θ) = 0 as well as R′ ($r = r_\theta$) for the low compression (large r_θ) are considered. Asymptotic expressions for the confluent hypergeometric functions were used. The energy shifts in both cases of the boundary conditions for large r_θ are found to be equal in value but opposite in sign. (auth)

13732 DIFFERENTIATION OF THE DIRAC–FOCK DENSITY MATRIX. Bolotin, A. B.; Rassikhin, V. V.; Yarkovoi, G. O. (Vilnyus State Univ., USSR). Liet. Fiz. Rinkinys; 13: No. 4, 511-518(1973). (In Russian).

Several forms of the solution of the matrix equation obtained through differentiation by the parameter of the condition of the idempotency of the Dirac–Fock density matrix were investigated. Advantages and disadvantages of the solution were discussed on the basis of molecules H_2^+ and LiH. (auth)

13733 ANALYTICAL RADIAL ORBITALS FOR THE HEAVY ATOMS. Kantseryavichyus, A. Yu. (Inst. of Physics and Mathematics, Vilnyus, USSR). Liet. Fiz. Rinkinys; 13: No. 2, 207-216 (1973). (In Russian).

Some modifications of the representation of the analytical radial orbitals are proposed: the partly dependent basis set and minimal extended basis set, which let to improve minimal basis set of orbitals to a great extent without elaborated calculations. The $\langle r^k \rangle$, f^k and ϵ_{nl} values for Ca, Ba and Hg atoms, calculated using various radial orbitals, are compared. The parameters of analytical radial orbitals for Cd, Ba, Hg atoms and U^{6+} ion are presented. (auth)

13734 CORRECTION FUNCTIONS TO HARTREE-FOCK ORBITALS DERIVED FROM CORRELATED WAVE FUNCTIONS FOR He-, Li-, AND Be-LIKE IONS. Taylor, G.K.; Banyard, K.E. (Department of Physics, University of Leicester, Leicester, England). Phys. Rev. A 8: No. 3, 1157-1165 (Sept 1973).

Using energetically reliable configuration-interaction and Hartree-Fock wave functions for He(^{1}S state) –, Li(^{2}S and ^{2}P states) –, and Be(^{1}S state)-like ions, we applied the method of successive partial orthogonalizations to determine orbital correction f functions (introduced by Sinanoğlu in his many-electron theory) which arise from electron-correlation effects. The addition of an f function to an appropriate Hartree-Fock orbital gives an improved orbital representation as far as the one-particle density is concerned. Hence, changes in the corresponding radial density distributions were obtained and their characteristics and Z-dependent trends were rationalized in terms of the fluctuation potential proposed by Sinanoğlu. For He-like ions, changes in the K-shell density showed strong split-shell characteristics. This also held for the K shell of the Be-like ions; however, as Z increased, the perturbative influence of the L shell became more apparent. In the L shells for the Be-like systems, because of the 2s–2p near degeneracy, angular correlation is relatively high and, consequently, the fluctuation potential gave rise to an f effect which produced an over-all density contraction towards the nucleus. These density changes for the 2s electrons are considerably larger than the changes associated with the K shells. At a low-Z value for Li(^{2}S)-like ions, spin polarization of the K shell owing to the unpaired L-shell electron is small, the changes in density being predominantly intrashell effects. For high Z, spin-polarization effects are greatly increased. The L-shell electron in the ^{2}S state experiences only an intershell fluctuation potential—which is purely attractive. For this state, the density changes for the outer electron are about 25% of the L-shell effect in the Be(^{1}S)-like ion and they are almost four times larger than

the corresponding K-shell effect. In the Li(^{2}P) series of ions, the K-shell density shifts due to the f functions are dominated by intrashell effects for Z = 3 whereas, at higher-Z values, an exchange effect becomes the major influence. Our results for the L shell appear less satisfactory and suggest that a further such study of the excited state of these ions would be of interest. (auth)

13735 CALCULATION OF THE g_J FACTOR FOR THE 2^3S_1 STATE OF HELIUM. Grotch, H. (Department of Physics, The Pennsylvania State University, University Park, Pennsylvania 16802); Hegstrom, R.A. Phys. Rev. A 8: No. 3, 1166-1168 (Sept 1973).

The g_J factor for the excited 2^3S_1 state of helium has been calculated from a generalized Breit equation which includes radiative corrections. The result is g_J (He, 2^3S_1) = g_s (1 − 40.91640 × 10^{-6}) = −2.002237379. This result is in good agreement with the previous theoretical value calculated by Perl and Hughes to order α^2. Higher-order corrections (α^3 and $\alpha^2 m/M$) contribute −0.151 ppm. Combining this result with the calculated value for the atomic hydrogen g_J factor gives the ratio g_J(He, 2^3S_1)/g_J(H, $1\,^2S_{(1/2)}$) = 1 − 23.212 × 10^{-6} with an estimated uncertainty of 3 × 10^{-9}. This value is in agreement with the old experimental and theoretical values of Hughes et al., and improves upon the accuracy of the latter, but disagrees with a recent experimental value obtained by Leduc, Laloë, and Brossel. (auth)

13736 FUNDAMENTAL INFRARED ABSORPTION OF H_2 AND D_2 IN SOLID RARE GASES. Taylor, D. W. (McMaster Univ., Hamilton, Ont.); De Remigis, J. Can. J. Phys.; 51: No. 10, 1075-1087(15 May 1973).

A theory of the infrared absorption due to the phonon sidebands on the vibrational/rotational transitions of H_2 molecules that are substitutional impurities in crystals is formulated in terms of displacement/displacement Green's functions. A sum rule for this absorption is derived and applied in detail to the systems H_2/Ar, H_2/Kr, and D_2/Ar for comparison with the experimental results. (auth)

13737 LYMAN AND WERNER BANDS OF DEUTERIUM. Bredohl, H.; Herzberg, G. (National Research Council of Canada, Ottawa). Can. J. Phys.; 51: No. 9, 867-887(1 May 1973).

The Lyman and Werner bands of D_2 were measured under high resolution, and their analysis was extended. From this analysis the rotational and vibrational levels of the ground state of D_2 were evaluated up to the last vibrational level v = 21 which lies only 2 cm^{-1} below the dissociation limit. The deviations of the observed $\Delta G(v + \frac{1}{2})$ and B_v values from theoretical values given by Kolos and Wolniewicz on the basis of ab initio calculations are very small but systematic and are probably due to the neglect of nonadiabatic corrections in the theoretical calculations. Similar comparisons were made for the lower vibrational levels of the B $^1\Sigma_u^+$ and C $^1\Pi_u$ states. The differences between theory and experiment are somewhat larger. The observed electronic excitation energies agree with the theoretical ones within 15 cm^{-1} for $^1\Sigma_u^+$ and 8 cm^{-1} for $^1\Pi_u$. (auth)

Positronium, Muonium, and Muonic and Mesic Atoms and Molecules

Refer also to abstracts 13213, 14262, and 14324.

13738 (BNL-18335, pp 200-236) NUCLEAR PHYSICS WITH STOPPING KAON BEAMS. Barnes, P. D. (Carnegie-Mellon Univ., Pittsburgh). 1973.

From conference on nuclear and hypernuclear physics with kaon beams; Upton, New York (2 Jul 1973).

In proceedings of the summer study meeting on nuclear and hypernuclear physics with kaon beams.

The status of nuclear physics with stopping kaon beams is reviewed with the kaonic atoms system chiefly discussed. K−N interactions from x rays, nuclear gamma rays, and electromagnetic interactions are covered. (JFP)

13739 (BNL-18335, pp 241-263) RECENT RESULTS ON K^-, p- AND Σ^- ATOMS. Tauscher, L. (CERN, Geneva). 1973.

From conference on nuclear and hypernuclear physics with kaon beams; Upton, New York (2 Jul 1973).

In proceedings of the summer study meeting on nuclear and hypernuclear physics with kaon beams.

Recent developments of the beam telescope at CERN are reported and discussed. Results from K^--, $\bar{p}$- and Σ^--atoms are reported, especially the widths of the upper levels of x-ray transitions. They are discussed in terms of an optical potential. The K^--mass determination is described and an upper limit for the K^- polarizability is given. Results on the Σ^- production by K^- absorption on nuclei are reported and discussed. (auth)

13740 ANOMALOUS μ^+ PRECESSION IN SILICON. Brewer, J.H.; Crowe, K.M.; Gygax, F.N.; Johnson, R.F.; Patterson, B.D. (Lawrence Berkeley Laboratory, University of California, Berkeley, California, 94720); Fleming, D.G.; Schenck, A. Phys. Rev. Lett. 31: No. 3, 143-146 (16 July 1973).

We have studied precession of polarized positive muons in quartz and silicon in transverse magnetic fields, via the asymmetric decay. We observed free muon precession and two-frequency muonium precession, as well as two anomalous precession frequencies apparent only in silicon. (auth)

13741 PRECISION EXPERIMENTS ON MUONIUM. III. RAMSEY RESONANCE IN ZERO FIELD. Favart, D.; McIntyre, P.M.; Stowell, D.Y.; Telegdi, V.L.; DeVoe, R. (The Enrico Fermi Institute and Department of Physics, The University of Chicago, Chicago, Illinois 60637); Swanson, R.A. Phys. Rev. A 8: No. 3, 1195-1218 (Sept 1973).

A novel method for measuring the hyperfine interval $\Delta\nu$ of muonium in zero magnetic field is described. It consists in applying two successive coherent microwave pulses (lengths τ, separation $T + \tau$) to muonium, and observing the change in muon polarization at $t > T + 2\tau$. By linearly extrapolating two low-pressure runs in Kr together with earlier Chicago data, we obtain $\Delta\nu$ (0) = 4463301.2(2.3) kHz (0.5 ppm). A joint fit of all available data in Ar and Kr yields $\Delta\nu$ (0) = 4463304.4(2.3) kHz. With μ_μ/μ_p = 3.183349(15) the latter implies (a) α^{-1} − 137 = 0.03631(32) (2.4 ppm), and (b) a proton polarizability δ'_p = 5.4(4.8) ppm. (auth)

13742 CORRECT NO-RETARDATION LIMIT IN BETHE-SALPETER KERNELS. Feldman, G.; Fulton, T.; Townsend, J. (Department of Physics, The Johns Hopkins University, Baltimore, Maryland 21218). Phys. Rev. A 8: No. 3, 1149-1156 (Sept 1973).

A careful discussion of the no-retardation (instantaneous) limit of the Bethe-Salpeter (BS) equation is carried out, as illustrated by one-photon exchange in the radiation gauge for positronium. Comparison is made with equations obtained by other authors, using the effective potential to order $m\alpha^4$ as a test. Detailed analysis, using a new approach to the BS equation, recently proposed by the authors, indicates that the equations do not give equivalent results to order $m\alpha^4$ and that the arguments leading to the experimentally well verified $m\alpha^4$ potentials are sometimes defective. (auth)

Collision Phenomena

Refer also to abstracts 13790, 13853, 13960, 13992, 14010, and 14355.

13743 DIATOMIC INTERACTION POTENTIAL THEORY. Volume 1. Fundamentals. Goodisman, J. Physical Chemistry. Volume 31-1. New York; Academic Press, Inc. (1973). 314p. $24.00.

Potential energy curves and methods of calculation are discussed. (JFP)

13744 DIATOMIC INTERACTION POTENTIAL THEORY. Volume 2. Applications. Goodisman, J. Physical Chemistry. Volume 31-2. New York; Academic Press, Inc. (1973). 425p. $34.00.

The discussion covers large and small distances, intermediate R, and semiempirical calculations and simple models. (JFP)

13745 THEORETICAL DETERMINATION OF THE EFFECTIVE CROSS SECTIONS OF LITHIUM ATOM BY THE ELECTRON IMPACT. Zhvirblis, P. S.; Nashlenas, E. P. (Inst. of Physics and Mathematics, Vilnyus, USSR). Liet. Fiz. Rinkinys; 13: No. 2, 217-220(1973). (In Russian).

The cross sections of excitation of a lithium atom by the electron impact are calculated using the first Born's approximation for transitions 2s − 2p, 2s − 3d, 2p − 3d. The radial orbitals used were found by the extended method of calculation. The calculated cross sections of excitation and those obtained previously are compared. The effects of the extended method of calculation for cross sections of excitation of lithium and helium atoms are compared. (auth)

13746 NUMERICAL SOLUTION OF SCATTERING EQUATIONS WITH NONLOCAL POTENTIALS. Thomas, L. D. (Univ. of Southern California, Los Angeles). J. Comput. Phys.; 13: No. 3, 348-362(Nov 1973).

A noniterative method, first communicated by Marriott, for solving the integro-differential equations which arise in electron–atom scattering theory, is developed for a general class of nonlocal potentials for both coupled and uncoupled equations. Algorithms are given for the numerical solution in the uncoupled case

using Simpson's rule for the quadrature scheme. As a sample calculation e^-–He elastic scattering phase shifts are calculated using the static-exchange approximation with a renormalized density matrix. Hartree–Fock phase shifts are tabulated for He and Ne and compared to previous calculations. (auth)

13747 HEAVY-ION-INDUCED X-RAY PRODUCTION IN SOLIDS. Taulbjerg, K.; Fastrup, B.; Laegsgaard, E. (Institute of Physics, University of Aarhus, DK 8000 Aarhus, Denmark). Phys. Rev. A 8: No. 4, 1814-1824 (Oct 1973).

The Fano–Lichten model is known to be in good accord with available inner-shell excitation data on gaseous targets, whereas there exist several examples of discrepancies between the model and results of solid-target experiments. As will be discussed in detail in this paper, these apparent discrepancies may be explained by so-called "solid effects." An equation taking due account of energy-loss straggling, x-ray generation in recoil collisions, and targets absorption of emitted x rays is used to relate the measured x-ray yield to an x-ray production cross section averaged over the equilibrium distribution of projectile charge states in the solid. Experimental cross sections are reported for the Al K x-ray production in Al targets bombarded with N, Al, and Ar ions, and for the Ne K x-ray production of Ne projectiles incident on Mg, Al, Si, and P targets. The neglect of solid effects in published x-ray data is commented upon. (auth)

13748 PROJECTILE AND TARGET DEPENDENCE OF THE K $K\alpha$ SATELLITE STRUCTURE. Kauffman, R.L.; McGuire, J.H.; Richard, P. (Kansas State University, Manhattan, Kansas 66506); Moore, C.F. Phys. Rev. A 8: No. 3, 1233-1240 (Sept 1973).

Proton, α-particle, and oxygen-ion beams are used to induce $K\alpha$ x-ray spectra in the elements Ca, Sc, Ti, V, Cr, and Mn. The target dependence of the satellite structure for $Z = 20$ to $Z = 25$ is studied. The relative intensity ratios for the production of one K-shell and multiple L-shell vacancies are measured. These ratios are compared with the predictions of the binary-encounter approximation (BEA) and the semiclassical approximation (SCA) for multiple ionization. The data strongly reflect the statistical approach used in the theories. The BEA theory agrees well with the proton and α-particle data but does not give good agreement with the oxygen data. (auth)

13749 IMPACT EXCITATION AND POLARIZATION OF THE EMITTED LIGHT*. Fano, U. (Department of Physics, The University of Chicago, Chicago, Illinois 60637); Macek, J.H. Rev. Mod. Phys. 45: No. 4, 553-573 (Oct 1973).

A new formulation is presented for the angular distribution and the polarization of light excited by atomic and electronic collisions and modulated in time by the action of internal and external fields. The formulation disentangles geometrical and dynamical effects and stresses the extraction of data on the alignment and orientation of radiating atoms from observations of the emitted light. The treatment is set in the context of recent experimental and theoretical literature and points to new avenues of research. (auth)

13750 IMPACT-PARAMETER METHOD FOR PROTON-HYDROGEN-ATOM COLLISIONS. III. THE USE OF NON-HYDROGENIC EXPANSION FUNCTIONS IN COUPLED-STATE CALCULATIONS. Storm, D.; Rapp, D. (The University of Texas at Dallas, P. O. Box 30365, Dallas, Texas 75230). Phys. Rev. A8: No. 4, 1784-1788(Oct 1973).

The boundary condition (at $t \to \infty$) previously shown to be associated with the customary time-dependent Schrödinger equation of the impact-parameter method places a restriction upon the approximate or trial wave functions which are to be used in the usual coupled-state calculations. For the trial wave function to be physically acceptable, it must belong to the class of functions which have the asymptotic form of the exact wave function. This simply means that one must obtain from the coupled-state calculation approximate transition amplitudes for which the absolute squares are time independent as $t \to \infty$. It is noted that the trial wave functions in the six-, eight-, and nine-state Sturmian calculations are not physically acceptable. The trial wave function in the pseudostate calculation of Cheshire, Gallaher, and Taylor is acceptable; however, if one attempted to include an additional pseudostate with the same symmetry as one already in the set, then this trial wave function would not be physically acceptable. (auth)

13751 COUPLED CHANNEL OPERATOR APPROACH TO e-H SCATTERING. Baer, M.; Kouri, D.J. (Department of Chemistry, University of Houston, Houston, Texas 77004). J. Math. Phys. (N.Y.) 14: No. 11, 1637-1642 (Nov 1973).

A coupled channel T operator formalism is applied to the problem of e-H collisions. Due to the electron–electron repulsion interaction, coupled integral equations for the direct and exchange amplitude density functions are obtained in contrast to the purely algebraic equations encountered in previous studies of model systems. These integral equations may be solved in a number of ways. One procedure involves the use of the Sams–Kouri homogeneous integral solution formalism to convert the integral equations into Volterra equations of the second kind. The kernals for these equations are such that a very rapid numerical solution may be obtained. Numerical results are presented for the special case of s-wave elastic scattering. (auth)

13752 INVESTIGATION OF THE NONCHARACTERISTIC X-RADIATION BAND OBSERVED IN Ar BOMBARDMENT OF VARIOUS TARGETS. Bissinger, G. (Rutgers University New Brunswick, New Jersey 08903); Feldman, L.C. Phys. Rev. A 8: No. 3, 1624-1629 (Sept 1973).

The noncharacteristic x-ray band produced by Ar bombardment of various targets has been investigated with a high-transmission window, a gas-flow proportional counter, and Si(Li) detectors. We find (i) that the Ar bombardment of Si produces a continuum with monotonically decreasing intensity for increasing energy, extending from $\lesssim 250$ eV to ~ 1.2 keV; (ii) Ar-target interactions and Ar-Ar interactions produce distinctly different spectra; and (iii) the band observed in the Ar-C system is inconsistent with a simple quasimolecular picture. The bearing of these results on the quasimolecular description is discussed. (auth)

13753 ABSOLUTE MEASUREMENTS OF TOTAL CROSS SECTIONS FOR ELECTRON SCATTERING BY SODIUM ATOMS (0.5–50 eV). Kasdan, A.; Miller, T.M.; Bederson, B. (Physics Department, New York University, New York, New York 10003). Phys. Rev. A 8: No. 3, 1562-1569 (Sept 1973).

Absolute measurements have been made of total cross sections for the scattering of electrons by sodium over the electron energy range 0.5–50 eV; some new data for potassium at 10, 20, and 50 eV are also presented. The measured cross sections for sodium range from 352 Å^2 at 0.5 eV, to 57 Å^2 at 50 eV, with over-all uncertainty of 13%. At very low energies, the 250-meV energy spread in our experiment introduces additional uncertainty. As with earlier measurements from this laboratory using potassium, we find excellent agreement with close-coupling calculations. (auth)

13754 PARAMETRIZATION OF THE CROSS SECTION FOR LOW-ENERGY ELECTRON–ATOM SCATTERING. Brandi, H.S. (Physics Department, Catholic University of Rio de Janeiro, Guanabara, Brazil); Koster, G.F. Phys. Rev. A 8: No. 3, 1303-1315 (Sept 1973).

Under the distorted-wave close-coupling approximation, an expression for the scattering amplitude is obtained. Assuming a Hartree–Fock solution for the atomic wave function, a parametrization of the inelastic-scattering cross section in terms of integrals over radial functions is derived. The formalism is then applied to singly ionized argon, using the distorted-wave appoximation. (auth)

13755 IMPACT IONIZATION IN THE PROTON-H-ATOM SYSTEM. V. FINAL-CROSS-SECTION CALCULATIONS. SethuRaman, V.; Thorson, W.R.; Lebeda, C.F. (Division of Theoretical Chemistry, Department of Chemistry, The University of Alberta, Edmonton, Alberta, Canada T6G 2G2). Phys. Rev. A 8: No. 3, 1316-1333 (Sept 1973).

The cross section $\sigma_1(\epsilon; E)$ has been calculated for the direct impact-ionization of hydrogen atoms by protons, $H^+ + H(1s) \to 2H^+ + e^-$, for low relative collision energies E between 100 and 500 eV, and all electron energies ϵ for which it is significant. Fundamental theory and most electronic matrix-element calculations were presented in earlier papers of the series. In the present paper we complete the electronic matrix-element calculations (in particular, the "optimization" of Coriolis or angular coupling matrix elements for ionizing transitions, through introduction of an angular velocity electron–translation factor); and we perform the final integrations over classical trajectories and impact parameters to obtain the cross sections. The cross sections $\sigma_1(\epsilon; E)$ show the expected steep falloff with increasing ϵ and decreasing E, owing to the increasing inefficiency of momentum and energy transfer from the heavy particles to the electron under such changes; σ_1 decreases by about two orders of magnitude from $E = 500$ eV to $E = 100$ eV, and by four orders of magnitude from $\epsilon = 0$ a.u. to $\epsilon = 1.0$ a.u. A strong dependence of cross section on isotopic mass at fixed E is also predicted thereby. Finally, the most significant conclusion is that the cross section for ionization from the $1s\sigma_u(2p\sigma_u)$ molecular electronic state is about 500 times greater than that for ionizing a $1s\sigma_g$ molecular electron, the main source of transitions being the Coriolis coupling operator. (auth)

13756 ELECTRONIC TRANSITIONS IN SLOW COLLISIONS OF ATOMS AND MOLECULES. V. MULTICHANNEL EIKONAL APPROXIMATION FOR THE DIFFERENTIAL (p^+, H) EXCITATION AND REARRANGEMENT COLLISIONS. Chen, J.C.Y.; Ishihara, T.; Ponce, V.H. (Department of Physics and Institute for Pure and Applied Physical Sciences, University of California, San Diego, La Jolla, California 92037); Watson, K.M. Phys. Rev. A 8: No. 3, 1334-1344 (Sept 1973).

The multichannel (p^+, H) collisions are investigated in the three-state approximation. In our formulation, precautions are taken to ensure that the state function has the correct asymptotic behavior. Consequently, the

spurious long-range interactions coming from the nonadiabatic interactions do not appear in our coupled equations. These coupled equations are solved in the straight-line eikonal approximation. The calculated differential elastic, electron-transfer, and $2p\pi$-excitation cross sections are compared with recent experimental data and other theoretical results. (auth)

13757 RESONANCE STRUCTURE IN THE EXCITATION CROSS SECTION BY ELECTRON IMPACT OF THE 2s STATE IN ATOMIC HYDROGEN. Koschmieder, H.; Raible, V.; Kleinpoppen, H. (Department of Physics, University of Stirling, Stirling, Scotland). Phys. Rev. A 8: No. 3, 1365-1368 (Sept 1973).

The cross section for excitation of atomic hydrogen to the 2s state by electron impact has been remeasured in a crossed-beam experiment in the energy range from threshold to 12.3 eV. An electron monochromator of the cylindrical type with a full width at half-maximum of 110 meV has been used. The 2s atoms were detected by quenching in an electrostatic field and observing the emitted Lyman-α photons. Absolute values for the cross section were obtained by normalizing to the close-coupling calculations of Burke et al. at 10.8 eV. Resonance structure at 11.7 eV, which is a superposition of the ^1S and ^3P resonances predicted by theory, has been detected. There is good agreement between the present experiment and the experiment by Oed. (auth)

13758 QUANTUM-MECHANICAL CALCULATION OF INELASTIC CROSS SECTIONS FOR $1\ ^1S \rightarrow 2\ ^3S$ EXCITATION COLLISIONS OF GROUND-STATE He ATOMS WITH He^+ IONS. Evans, S.A. (Texas Instruments, Dallas, Texas 75222); Lane, N.F. Phys. Rev. A 8: No. 3, 1385-1396 (Sept 1973).

Quantum-mechanical, three-state, close-coupling calculations of the inelastic cross sections for $1\ ^1S \rightarrow 2\ ^3S$ excitation of ground-state He atoms in collision with He^+ ions have been carried out for energies between 25 and 50 eV (c.m.). Differential, partially integrated (over small angles), and total inelastic cross sections were obtained. The calculations were performed using linear combinations of three single-configuration, valence-bond-type electronic wave functions as the basis of a diabatic representation. The diabatic coupling in the vicinity of the well-established $^2\Sigma^+_g$ curve crossing at $R \simeq 1.5a_0$ was found to be small, and it was verified by comparison with the close-coupling results that the Stueckelburg-Landau-Zener (SLZ) theory was applicable. Several SLZ model calculations were performed using the best available adiabatic potential curves and modeling the crossing region. The resulting differential and partially integrated (over small angles) cross sections were found to be in good qualitative agreement with the measurements. In particular, the strange hump apparent in the small-angle cross sections versus energy curve, which was first found by Utterback, and recently confirmed by MacVicar-Whelan and Borst, was reproduced in our calculations. The interesting nature of the small-angle scattering is discussed, and the sensitivity of the cross section to details of the potential curves near the crossing is examined in detail. (auth)

13759 EXCITATION OF THE K LINES OF COPPER BY ALKALI-METAL IONS IN THE ENERGY RANGE OF 1 TO 5 MeV. Van Rinsvelt, H.A. (Department of Physics, University of Florida, Gainesville, Florida 32601); Brown, L.; Assousa, G.E. Phys. Rev. A 8: No. 3, 1412-1415 (Sept 1973).

Energy shifts and thick target yields of the copper Kα and Kβ x-ray lines have been produced with alkali-metal ions of a few MeV. Sodium, potassium, rubidium, and cesium give shifts that are nearly independent of energy and atomic number and slightly larger than the shift that would be observed for one hole in the L shell. The yields are very strongly dependent on both energy and atomic number. Coulomb excitation with a binding-energy correction reproduces the yields for lithium and sodium but fails by many orders of magnitude for potassium, rubidium, and cesium, suggesting electron promotion as the excitation mechanism. (auth)

13760 ELECTRON CAPTURE FROM ARGON BY MULTIPLY CHARGED ATOMIC-OXYGEN IONS. Mapleton, R.A. (Air Force Cambridge Research Laboratories, Bedford, Massachusetts 01730); Doherty, R.; Meehan, P. Phys. Rev. A 8: No. 3, 1648-1650 (Sept 1973).

The first Born approximation with the incident-ion-electron interaction (OBK) was used to calculate cross sections for capture of electrons from Ar by multiply charged atomic-oxygen ions. This calculation was effected for five different incident ions. O^{i+}, i = 8, 7, 6, 5, 4. Cross sections Q_n were calculated for capture from each subshell of Ar into the ground state, and for a few of the excited states of the final ion $O^{(i-1)+}$. However, no cross sections were calculated for capture into excited states of O^{8+} by reason of the apparent lack of analytic wave functions for these states. The calculated ratios, $r_i = [\Sigma_n Q_n(i \rightarrow i-1)]/[\Sigma_m Q_m(i-1 \rightarrow i-2)]$ i = 8, 7, 6, 5, are compared with the corresponding ratios of measured total cross sections for single electronic capture. The calculated r_i do not predict the ratios of measured cross sections very well in the range of impact energies of the measurements, $10 \leq E \leq 40$ MeV. For i = 7, 6, 5, all of the calculated r_i, except r_6 (10 MeV), underestimate by factors F in the range $1 < F \leq 5.8$. For i = 8 the prediction overstimates by a factor of 9 at E = 10 MeV, but at E = 40 MeV the factor is 1.96. The greatest disagreement occurs for i = 8, 7, this discrepancy perhaps indicating the importance of contributions for capture into excited states of O^{6+}. (auth)

13761 PROCEDURE FOR COMPUTING CROSS SECTIONS FOR SINGLE AND MULTIPLE IONIZATION OF ATOMS IN THE BINARY-ENCOUNTER APPROXIMATION BY THE IMPACT OF HEAVY CHARGED PARTICLES. McGuire, J.H.; Richard, P. (Department of Physics, Kansas State University, Manhattan, Kansas 66506). Phys. Rev. A 8: No. 3, 1374-1384 (Sept 1973).

A procedure is developed for computing cross sections for the multiple ionization of atoms by the impact of protons or other fully stripped nuclei. The ionization probability, as a function of energy and impact parameter, P(E, b), is computed at several beam energies in the binary-encounter approximation for a ground-state hydrogenic electron scattered by an incident proton. Scaling laws are given which may be used to extend these results to other projectiles, other targets, and other hydrogenlike filled atomic shells. It is shown that $P(E, O) = \langle \sigma(E, r)/2\pi r^3 \rangle$ for isotropic, but otherwise arbitrary, electron-density distributions. A formulation for multiple-ionization cross sections is developed in terms of the single-electron probabilities P(E, b) for each atomic shell, assuming that both the electrons and the shells are mutually independent. Numerical calculations are compared to recent predictions in the semiclassical Coulomb approximation and to recent satellite and hypersatellite x-ray data. The discrepancies are generally within those resulting from uncertainties of 30-200% in the single-ionization cross sections, when the ionization probability is much less than one. Then, approximating P(E,b) vs b as a step function, the multiple-ionization cross sections are reduced to simple combinations of single-ionization cross sections. These single-ionization cross sections may be evaluated in the binary-encounter approximation by applying scaling laws to the usual universal curve that we tabulate. Multiple-ionization cross sections may thus be estimated without the aid of a computer. (auth)

13762 ENERGY DEPENDENCE OF MULTIPLE INNER-SHELL IONIZATION OF Al BY ALPHA-PARTICLE BOMBARDMENT. Richard, P.; Kauffman, R.L.; McGuire, J.H. (Kansas State University, Manhattan, Kansas 66506); Moore, C.F.; Olsen, D.K. Phys. Rev. A 8: No. 3, 1369-1374 (Sept 1973).

The excitation of states in Al with single K- plus multiple L-shell vacancies formed by collisions with 0.4-3.0-MeV helium ions is studied by observing the x-ray decay associated with filling of the K-shell vacancy. The observed K x rays come from initial states with one K-shell and 0, 1, 2, and 3 L-shell vacancies. The absolute cross section for each of these transitions is determined and compared to a calculation using multiple Coulomb ionization. An important result of this experiment is the observation that the ratio of double to single ionization exhibits a maximum at a bombarding energy near the maximum for L-shell ionization. (auth)

13763 GLAUBER-EIKONAL APPROXIMATION WITH "ANGLE" TRAJECTORIES: APPLICATION TO INELASTIC (e, H) SCATTERING. Hambro, L.; Chen, J.C.Y.; Ishihara, T. (Department of Physics and Institute of Pure and Applied Physical Sciences, University of California, San Diego, La Jolla, California 92037). Phys. Rev. A 8: No. 3, 1283-1288 (Sept 1973).

A Glauber-type eikonal approximation with the classical trajectories taken as two intersecting straight-line segments (called "angle" trajectories) is examined and applied to the 2s and 2p excitation of hydrogen atoms by electron impact. The calculated differential and total excitation cross sections are compared with experimentally measured and "straight-line" Glauber-eikonal cross sections. The angle approximation does provide a significant improvement over the straight-line approximation for the differential cross section at angles >40 °. (auth)

13764 ELASTIC ELECTRON-ATOM SCATTERING AT INTERMEDIATE ENERGIES. Byron, F.W. Jr. (Department of Physics, University of Massachusetts, Amherst, Massachusetts 01002); Joachain, C.J. Phys. Rev. A 8: No. 3, 1267-1282 (Sept 1973).

We analyze elastic electron-atom scattering at intermediate and high energies by combining the Born series and eikonal series to get a consistent picture of the scattering amplitude through order k_i^{-2}. Our eikonal-Born-series approach is compared with the usual Glauber approximation, which is shown to be seriously deficient. We also discuss the Schwinger variational principle, exchange effects, and forward dispersion relations. Applications are made to the elastic scattering of electrons by atomic hydrogen and helium. The agreement between our results and the experimental data is very good. (auth)

13765 SIMULTANEOUS K-PLUS-L-SHELL IONIZATION IN LIGHT-ION-ATOM COLLISIONS. Li, T.K.; Watson, R.L.; Hansen, J.S. (Department of Chemistry and Cyclotron Institute, Texas A&M University, College Station, Texas 77843). Phys. Rev. A 8: No. 3, 1258-1266 (Sept 1973).

The probability of simultaneous K–plus–L–shell ionization in collisions between Ca, Ti, and Fe target atoms and projectiles of 1.5–12.5–MeV/amu deuterons and α particles has been investigated. The results show that the fraction of Kβ x rays emitted in the presence of an L–shell vacancy (a) decreases with increasing projectile velocity above a projectile–to–L–shell–electron velocity ratio of 1; (b) decreases with increasing target atomic number; and (c) increases with projectile charge (approximately as $z^{\frac{1}{2}}$). The projectile velocity dependence is in fairly good agreement with a simple classical model based upon the assumption that multiple–vacancy production results from simultaneous Coulomb collisions with K– and L–shell electrons during the ion's passage through the atom. (auth)

13766 LOW–ENERGY ATOM–ATOM SCATTERING: CORRECTIONS TO THE He–He INTERACTION. Mittleman, M.H.; Tai, H. (Physics Department, The City College of the City University of New York, New York, New York 10031). Phys. Rev. A 8: No. 4, 1880-1891 (Oct 1973).

A formalism, previously presented, for describing atom–atom scattering in the adiabatic representation to higher orders in m/M is generalized to describe the problem of different isotopes and different atoms. This is accomplished by a sequence of nonlinear coordinate transformations which introduce a "switching function" which is defined only in the asymptotic limit of separated atoms. It is found that the effective potential for elastic scattering contains energy–dependent terms in order m/M and that it also depends upon the switching function in this order so that the potential is not unique. It is also found that in this order the definition of adiabatic states is not a trivial problem. A variational choice is made for the switching function and explicit calculations are presented for the He–He interaction. The coupled equations describing transitions are then derived and it is shown that terms are omitted from the usual coupling operator which are of the same order of magnitude as the one usually kept. This leads to a modification of the usual Landau–Zener transition formula. (auth)

13767 YIELD RATIOS, Kα/Kβ, Lα/Lβ, Lα/Lγ, AND Lα/Ll, FOR X RAYS PRODUCED BY PROTONS OF 1.0 TO 3.7 MeV. Close, D.A.; Bearse, R.C.; Malanify, J.J.; Umbarger, C.J. (Nuclear Analysis Research Group, University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87544). Phys. Rev. A 8: No. 4, 1873-1879 (Oct 1973).

Kα/Kβ x–ray yield ratios have been determined for eleven elements, Ti, V, Fe, Ni, Cu, Ge, Rb, Zr, Ag, Sn, and Sb, when bombarded with protons of 1.00, 2.25, and 3.00 MeV. Excitation functions of Kα/Kβ ratios for Ni, Ge, and Ag were also measured from 1.00 to 3.70 MeV in 100–keV steps, and these ratios were found to be constant with proton energy. For the ten elements Ce, Sm, Dy, Tm, W, Au, Pb, Bi, Th, and U, the yield ratios Lα/Lβ, Lα/Lγ, and Lα/Ll were determined for proton bombarding energies of 1.00, 2.25, and 3.00 MeV. Excitation functions for these same ratios were measured for Sm, W, and Th for proton energies between 1.00 and 3.70 MeV in 100–keV steps. While the Lα/Lβ and Lα/Lγ ratios varied significantly with proton energy, the Lα/Ll ratio was found to be constant as a function of proton energy. Additionally, the energy of the centroid of the peak corresponding to the Lα, Lβ, and Lγ x–ray transitions was measured as a function of proton energy for Sm, W, and Th. The Lβ and Lγ centroid energies changed appreciably with proton energy, while the Lα centroid energy remained constant. The experimental yield ratios and centroid energies are compared to plane–wave–Born– and binary–encounter–approximation predictions. (auth)

13768 DEPENDENCE OF ARGON K–SHELL VACANCY PRODUCTION ON THE ELECTRONIC STRUCTURE OF SWIFT HEAVY PROJECTILES. Winters, L.M.; Macdonald, J.R.; Brown, M.D.; Chiao, T.; Ellsworth, L.D.; Pettus, E.W. (Department of Physics, and Nuclear Science Laboratory, Kansas State University, Manhattan, Kansas 66506). Phys. Rev. A 8: No. 4, 1835-1843 (Oct 1973).

Thin gas targets of argon were bombarded with C, N, O, and F projectiles of various incident charge states at energies from 1 to 2 MeV/amu. Argon K x rays were observed with a Si(Li) detector, and x–ray–production cross sections were obtained. For a given–energy projectile, the cross sections decrease approximately exponentially as the number of electrons bound to the incident projectile increases from 0 to 3. For three or more electrons, the measured cross sections change very little. Hartree–Fock calculations of fluorescence yields as a function of target configuration were used to obtain argon K–shell vacancy–production cross sections. Target configurations were chosen by comparing the experimental argon Kα and Kβ x–ray energies and Kβ/Kα relative intensities with the values obtained by Hartree–Fock calculations. For projectiles with more than one electron, the vacancy–production cross sections scale as the square of projectile nuclear charge as expected for Coulomb ionization, but the absolute magnitudes of the cross sections do not agree with Coulomb–ionization results. For projectiles with 0 to 1 electron, however, Coulomb ionization alone cannot explain the observed cross sections. Charge exchange from the argon K shell to projectile bound states has been proposed as a significant vacancy–producing mechanism for collisions involving highly charged projectiles. Although calculations of the charge–exchange cross sections are in reasonable relative agreement with the data, additional vacancy–producing mechanisms cannot be ignored. (auth)

13769 RESONANT STRUCTURE IN NEAR–THRESHOLD ELECTRON EXCITATION OF KRYPTON. Swanson, N.; Cooper, J.W.; Kuyatt, C.E. (National Bureau of Standards, Washington, D. C. 20234). Phys. Rev. A 8: No. 4, 1825-1834 (Oct 1973).

Using a monochromator–analyzer combination, electron–excitation functions of the lowest–lying electronic states of krypton have been obtained at a scattering angle of 45 ° in the near–threshold region (9–14 eV). All excitation functions display a complex resonant structure. Additional data have been obtained on elastic scattering at 45 ° to provide further information on the resonances. In addition to the $4p^5 5s^2$ J = 3/2, 1/2 resonance doublet, a number of narrow resonances appear below about 12 eV in both the excitation data and elastic scattering which correlate in energy with recent measurements on transmission by Sanche and Schulz. Broad resonant structure is found in a number of the excitation curves and the excitation process in the near–threshold region appears to be dominated by resonant effects. An analysis of the elastic–scattering data on the $4p^5 5s^2$ doublet is presented and resonance parameters obtained compared with theory. A comparison of the narrow resonant structure data with optical absorption data on Rb I obtained by Beutler indicates that the narrow resonances in the 10.5–12–eV region are probably due to levels of the $4p^5 5s4d$ configuration. (auth)

13770 SEMIPRECISION CALCULATIONS OF ELECTRON–HYDROGEN RESONANCES. Bhatia, A.K.; Temkin, A. (Theoretical Studies Branch, Goddard Space Flight Center, National Aeronautics and Space Administration, Greenbelt, Maryland 20771). Phys. Rev. A 8: No. 4, 2184-2186 (Oct 1973).

Reliable calculations of the shift (Δ) and width (Γ) are combined with precision calculations of the unshifted energy (E) to obtain the position and width of the lowest ^1S resonance in e–H scattering. These values together with our previous results for the two higher, ^3P and ^1D, resonances are compared with the previous most–accurate calculations and some differences are noted. Comparison with experiment is also made. (auth)

13771 GLAUBER CROSS SECTIONS FOR EXCITATION OF THE 2 ^1S STATE OF HELIUM BY ELECTRON AND POSITRON IMPACT. Chan, F.T.; Chen, S.T. (Physics Department, University of Arkansas, Fayetteville, Arkansas 72701). Phys. Rev. A 8: No. 4, 2191-2194 (Oct 1973).

The recently proposed analytic methods, which reduce the Glauber amplitude for charged–particle–neutral–atom collisions to a one–dimensional integral representation involving modified Lommel functions, are used to evaluate the cross sections for the direct excitation of the 2 ^1S state of helium by electron and positron impact. Comparison is made with the Coulomb–projected Born approximation of Hidalgo and Geltman and the truncated eigenfunction–expansion method of Berrington, Bransden, and Coleman. (auth)

13772 IMPACT–PARAMETER METHOD FOR PROTON-HYDROGEN-ATOM COLLISIONS. I. TIME-DEPENDENT IMPACT–PARAMETER MODEL. Storm, D. (The University of Texas at Dallas, Dallas, Texas 75230). Phys. Rev. A 8: No. 4, 1765-1776 (Oct 1973).

The impact–parameter method used to calculate cross sections in high–energy proton–hydrogen–atom collisions is considered. By making use of the observation that the scattering is almost completely in the forward direction, a complete time–dependent impact–parameter model is obtained from the Lippmann–Schwinger equation. As a direct consequence of the proper treatment of the continuum, two equivalent Schrödinger time representations are found in which to describe the model system of a point charge moving along a specified trajectory, and thereby perturbing a hydrogen atom. The unambiguous identification of the dynamical states of this model system and the unambiguous definition of transition probabilities are obtained. The specification of the dynamical states of the time–dependent model system can be conveniently incorporated into the customary impact–parameter method by associating an additional boundary condition with the usual time–dependent Schrödinger equation. The familiar traveling atomic orbitals are not dynamical states of the system, but the discrete dynamical states approach the traveling orbitals as $|t| \to \infty$; hence, the set of traveling atomic orbitals provides a description of the system which becomes correct asymptotically. One Schrödinger representation is the natural representation in which to obtain the amplitudes for electronic excitation. The other representation is the natural representation in which to obtain the amplitudes for charge exchange. A noniterative technique is used to solve the integral equations which describe the evolution of the state vector in the two time representations, and expressions are derived for the amplitudes for excitation and charge exchange. The amplitudes for excitation can be expressed in terms of the usual Coulomb integrals, and the amplitudes

for charge exchange can be expressed in terms of the usual exchange integrals. (auth)

13773 IMPACT-PARAMETER METHOD FOR PROTON-HYDROGEN-ATOM COLLISIONS. II. COUPLED-STATE CALCULATION, AND CONVERGENCE OF THE TWO-CENTERED TRAVELING HYDROGENIC EXPANSION. Storm, D. (The University of Texas at Dallas, P. O. Box 30365, Dallas, Texas 75230). Phys. Rev. A 8: No. 4, 1777-1783 (Oct 1973).

Several calculational procedures for generating approximate solutions to the time-dependent Schrödinger equation of the impact-parameter model are discussed in this work. It is emphasized that in these calculational procedures a trial wave function is selected from a definite class of functions—the class of functions which have the asymptotic form of the exact wave function—and then some property satisfied by the exact wave function is used to fix the trial wave function. The customary set of coupled equations can be obtained by requiring that the Schrödinger equation be satisfied in the subspace defined by the basis set used to express the trial wave function. Recently, it has been popular to show that these coupled equations follow by making certain functionals stationary. It is shown, however, that these functionals are not stationary about the exact solution for the variations represented by available trial wave functions which, as they must, reflect our ignorance of the exact nature of the true wave function. In this work, a functional related to the norm of the exact wave function is given, and this functional is shown to be stationary about the exact wave function for the variations represented by available trial wave functions. A calculational procedure based upon the stationary property of this functional is given by which variational parameters in a trial wave function can be determined. If these parameters are taken to be time-varying nuclear charges in the basis functions, one obtains the equations given by Cheshire. Finally, the question of convergence of the two-centered traveling hydrogenic orbital expansion is considered. We conclude that the two-centered expansion does not provide a scheme by which a sequence of approximate wave functions can be generated that converges to the exact wave function. However, it appears from the comparison of the approximate cross sections obtained in two-, four-, eight-, and 14-state calculations that the cross sections for the 1s-exchange reaction and possibly for the 2s transitions may be tending to limiting values. (auth)

13774 IMPACT-PARAMETER METHOD FOR PROTON-HYDROGEN-ATOM COLLISIONS. IV. VARIATIONAL METHODS FOR TIME-DEPENDENT IMPACT-PARAMETER MODEL. Storm, D. (The University of Texas at Dallas, Dallas, Texas 75230). Phys. Rev. A 8: No. 4, 1789-1796 (Oct 1973).

A stationary functional and two variational principles are given in this work by which approximate transition amplitudes for the charge-exchange and electronic excitation processes occurring in proton–hydrogen–atom scattering can be calculated. The calculated transition amplitudes will be "second-order accurate." It is demonstrated how the stationary property of the functional can be used for a general variation to determine optimal approximate wave functions. The equations for these wave functions should be no more difficult to solve than the usual set of coupled equations, and the solution will automatically satisfy the unitary condition and the condition imposed by the time-reversal symmetry of the Hamiltonian. An upper bound on the second-order error term is derived which only depends upon the interaction and the trial wave function. The upper bound approaches zero as the error between the exact and trial wave functions vanishes, and thus the magnitude of the upper bound is a measure of the quality of a trial wave function. In addition, this upper bound can be used in conjunction with the variational principles to obtain upper and lower bounds which bracket the absolute values of the exact transition amplitudes; thus, one can in principle obtain exact values for the transition amplitudes to any desired accuracy. One of the variational principles offers the advantage that the trial wave function need not satisfy any asymptotic conditions. With this variational principle, one can therefore circumvent the difficulties associated with the use of Sturmian or pseudostate basis functions. (auth)

13775 ELECTRON-IMPACT EXCITATION OF THE ARGON ATOM. Ballou, J.K.; Lin, C.C. (Department of Physics, University of Wisconsin, Madison, Wisconsin 53706); Fajen, F.E. Phys. Rev. A 8: No. 4, 1797-1807 (Oct 1973).

Electron excitation functions of some thirty states of the $3p^5ns$, $3p^5np$, and $3p^5nd$ configurations of the argon atom have been measured by the optical method. In order to evaluate the level cross sections from the optical excitation cross sections, we have determined the branching ratios experimentally by measuring in an argon discharge tube the relative intensities of the emission lines originating from the level of interest. This procedure gives more accurate level cross sections than does the conventional approach of using theoretical transition probabilities to form the branching ratios since for an atom as complex as argon the wave functions of the excited states calculated by a semiempirical treatment of the fine structure are not always of sufficient accuracy to give reliable transition probabilites. Analysis of the shape of the excitation functions is facilitated by expressing the wave functions of the excited states of argon in terms of the LS eigenfunctions, and the special features of the experimental data of excitation functions can be readily explained by generalizing the results of helium. Analogous to the case of neon, one can show theoretically that within a configuration $3p^5nl$, the states with odd values of $J + 1$ in general have larger excitation cross sections than the ones with even values at incident energies well above the threshold, and that in general $Q(J = 0) > Q(J = 2)$, $Q(J = 1) \gtrsim Q(J = 3)$ for the np states, and $Q(J = 1) > Q(J = 3)$, $Q(J = 2) > Q(J = 0,4)$ for nd. The experimental results of the excitation cross sections are found to be in good agreement with these rules. (auth)

13776 STUDIES OF NONRESONANT CHARGE TRANSFER BETWEEN ATOMIC IONS AND ATOMS. Johnsen, R.; Leu, M.T. (Physics Department, University of Pittsburgh, Pittsburgh, Pennsylvania 15260); Biondi, M.A. Phys. Rev. A 8: No. 4, 1808-1813 (Oct 1973).

Measurements of nonresonant charge transfer between atomic ions and atoms have been made in a drift-tube—mass-spectrometer apparatus as a function of E/p (drift field/gas pressure) at 295 K. At E/p = 0 the charge-transfer coefficients are: $k(He^+, Hg) = (1.6 \pm 0.3) \times 10^{-9}$ cm^3/sec, $k(Ar^+, Hg) = (1.52 \pm 0.3) \times 10^{-11}$, $k(Kr^+, Hg) = (8.5 \pm 2) \times 10^{-12}$. For $Ne^+ + Hg$ and $Xe^+ + Hg$, k is $\leq 10^{-13}$, while for $He^+ + Ne$ and $He^+ + Ar$, k is $\leq 10^{-13}$ cm^3/sec. Little dependence of $k(He^+, Hg)$ and $k(Ar^+, Hg)$ on ion energy is found up to mean energies of ≈ 0.25 eV. Comparison of the measured rates with available theories suggests an inability to predict the moderately slow reaction rates. (auth)

13777 EXCITATION OF THE RESONANCE LINES OF Ar BY ELECTRONS. McConkey, J. W.; Donaldson, F. G. (Univ. of Windsor, Ont.). Can. J. Phys.; 51: No. 9, 914-921(1 May 1973).

"Polarization-free" measurements are presented of the electron impact excitation of the 1048 and 1067 Å resonance lines of argon in the energy range 10 to 2000 eV. Cross sections are made absolute by normalizing to the optical oscillator strength of the 1048 Å line. Cascade is shown to play a major role in the excitation of the 4s levels. Comparison is made with other experimental results and with theory where available. (auth)

13778 SEARCH FOR THE FIRST 0^+ EXCITED STATE IN ^{90}Sr. Singh, B.; Johns, M. W. (McMaster Univ., Hamilton Ont.). Can. J. Phys.; 51: No. 8, 865-866(15 Apr 1973).

Gamma–gamma cascades of the form $I-2-0$ involving the 2^+ state at 831.5 keV in ^{90}Sr were studied with a NaI(Tl)–Ge(Li) coincidence spectrometer to search for 0^+ states in this nucleus. None of the eight cascades examined show the strong anisotropy characteristic of a $0-2-0$ cascade. On the basis of these measurements and the beta and gamma transition intensities, the spins of the 1655, 1892, and 2207 keV states which had been proposed as candidates for the two-phonon triplet are 4 or 3, 2 or 3, and 3 or 2 respectively. Although unique spin assignments are not possible, the spin 0 choice is completely excluded. (auth)

13779 PHOTON EMISSION STRUCTURES OF He BOMBARDED BY MONOKINETIC ELECTRONS IN THE 60 eV REGION. Marchand, P. D. (Univ., Laval, Quebec). Can. J. Phys.; 51: No. 8, 814-819(15 Apr 1973). (In French).

By measuring the photon intensity emitted by He excited by electron impact in the 60 eV region as a function of the electron energy, with an apparatus capable of excellent signal to noise ratio and energy resolution, several structures were observed, some being entirely new and attributed to levels of the negative He^- ion. (auth)

13780 VELOCITY DEPENDENCE OF THE TOTAL IONIZATION CROSS SECTION OF Ar ATOMS BY METASTABLE He ATOMS. Pesnelle, A.; Hourdin, H.; Watel, G.; Manus, C. (Institut de France, Paris). J. Phys., B (London); 6: No. 11, L326-L329(Nov 1973).

The total ionization cross section of Ar atoms by metastable He atoms was measured in the relative velocity range of 1 to 4×10^5 cm s^{-1} by an atomic beam time of flight method, and is compared with the existing theoretical results. (auth)

13781 EXCITATION IN FAST $He(2^3S)-He(1^1S)$ COLLISIONS. McCullough, R. W.; Simpson, F. R.; Gilbody, H. B. (Queen's Univ., Belfast). J. Phys., B (London); 6: No. 11, L322-L325 (Nov 1973).

Excitation of the 4^3S and 4^3D states of helium in $He(2^3S)-He(1^1S)$ collisions was studied in the energy range 20 to 100 keV. Cross sections for the excitation of the $He(1^1S)$ target and $He(2^3S)$ projectile to these levels were separately determined and shown to considerably exceed corresponding cross sections for excitation in $He(1^1S)-He(1^1S)$ collisions. (auth)

13782 COHERENCE TRANSFER BETWEEN THE $3^2P_{\frac{3}{2}}$ AND $3^2P_{\frac{1}{2}}$ STATES IN SODIUM, INDUCED IN COLLISIONS WITH NOBLE GAS ATOMS. Niewitecka, B.; Krause, L. (Univ. of Windsor,

Ont.). Can. J. Phys.; 51: No. 9, 993-997(1 May 1973).

Coherence transfer accompanying $3^2P_{\frac{1}{2}} \rightarrow 3^2P_{\frac{3}{2}}$ excitation transfer in sodium, induced in collisions with noble gas atoms, was investigated using methods of sensitized fluorescence. Oriented $3^2P_{\frac{1}{2}}$ sodium atoms were produced by irradiating a mixture of sodium vapor and a noble gas with $D_1\sigma^+$ resonance radiation, and their subsequent collisions with the buffer gas atoms resulted in the simultaneous transfer of coherence and excitation from the $^2P_{\frac{1}{2}}$ state to the $^2P_{\frac{3}{2}}$ state. Measurements of the ratio of circular polarizations of the D_2 sensitized fluorescence and D_1 resonance fluorescence resulted in the following cross sections for coherence transfer. Na–He: 7.1 ± 0.7 Å^2; Na–Ne: 6.2 ± 0.6 Å^2; Na–Ar: 12.0 ± 1.2 Å^2; Na–Kr: 6.8 ± 0.7 Å^2; Na–Xe: 6.9 ± 0.7 Å^2. (auth)

13783 INELASTIC SCATTERING IN He + He COLLISIONS. Morgenstern, R.; Barat, M.; Lorents, D. C. (Stanford Research Inst., Menlo, CA). J. Phys., B (London); 6: No. 11, L330-L333 (Nov 1973).

Inelastic differential scattering cross sections were measured in the laboratory energy range of 200 to 350 eV using a time of flight technique. Energy losses are observed corresponding to excitation of each of the channels He($1s^2$) + He(1s21) and He(1s21) + He(1s21). The results confirm the initial step in the recently proposed ionization mechanism of two electron excitation followed by autoionization as the particles dissociate. (auth)

13784 BIFUNCTIONATE SOLUTIONS TO THE SCHROEDINGER EQUATION FOR REACTIVE, THREE-ATOM, COLLINEAR ENCOUNTERS. Meister, J. J. Pasadena, CA; California Inst. of Tech. (1973). 282p. University Microfilms Order No. 73-31,050. Thesis (Ph. D.).

Two methods for solving the Schrödinger equation for one-dimensional, three atom, electronically adiabatic, reactive collisions were investigated. The first bifunctionate method was proposed by Diestler in 1969. It solves for vibrational excitation probabilities by expanding two parts of the total solution to the scattering problem in eigenfunctions of the unperturbed diatoms. These diatoms are the target and product diatoms in the reactive encounter. This formalism allows the eigenfunction series representation of the total solution to decay to zero in the interaction region of the reaction. Proposition 1 shows that this decay process is indicative of a failure in Diestler's method which renders its solutions invalid. A technique proposed as a means of solving the equations governing nuclear collisions was also investigated. This formalism, called the method of subtracted asymptotics, was shown to be an application of the general mechanism of eigenfunction expansion to the scattering problem. Because of analysis problems induced by the extensive eigenfunction series demanded by this method, the method of subtracted asymptotics is not an efficient or practical manner of solving the scattering problem. Tests used to verify the numerical accuracy of several studies of the method of subtracted asymptotics required the value of several special functions on the complex plane. To meet these needs, algorithms which compute the value of a complex number raised to a complex power, the gamma function, the digamma function and the hypergeometric function were prepared. These algorithms are discussed and presented. (Diss. Abstr. Int., B)

Atomic Theory

Refer also to abstract 14522.

13785 GENERALIZED QUASISPIN OPERATOR. Rudzikas, Z.; Spakauskas, V. (Inst. of Physics and Mathematics, Vilnyus, USSR). Liet. Fiz. Rinkinys; 13: No. 2, 181-190(1973). (In Russian).

A generalized quasispin operator was proposed. The commutation relations that the generalized quasispin operator components must satisfy were obtained. The matrix elements of all these commutators in the case of the configuration l^N were given. The new relations between the fractional parentage coefficients with one and two detached electrons and the matrix elements of the irreducible tensorial operators $W^{(l_1 S_1)}$ were obtained. Some peculiarities and the special cases were discussed. (auth)

13786 MULTICONFIGURATION APPROXIMATION FOR THE OUTER SHELLS OF THE ATOMS IN THE $3p^N$ AND $4p^N$ CONFIGURATIONS. Kantseryavichyus, A. Yu.; Bolotin, V. A. (Inst. of Physics and Mathematics, Vilnyus, USSR). Liet. Fiz. Rinkinys; 13: No. 4, 495-503(1973). (In Russian).

The multiconfiguration approximation $np^N + \Sigma np^{N-2}(L_1S_1)n_1l_1^2(L_2S_2)$ is applied to the atoms and their positive ions with outer shells $3p^N$ and $4p^N$ (N = 2, 3, 4, 5, 6). The configurations with $n_1l_1 = 3d^2$, $4p^2$, $4d^2$, $4f^2$, $4s^2$ (in the case of $3p^N$ shell) and $n_1l_1 = 4d^2$, $4f^2$, $5s^2$, $5p^2$ (in the case of $4p^N$ shell) with all intermediate momenta L_1S_1, L_2S_2 are included as correction terms. The numerical values of the energy corrections and the term ratios R are listed. The calculations are carried out using analytical radial orbitals. (auth)

13787 MOTION OF ATOMS IN THE ELECTROMAGNETIC FIELD. Flutak, J.; Engels, Z. (Univ. of Gdansk, Poland). Acta Phys. Pol.; A44: No. 6, 795-803(Dec 1973).

The interaction of moving atoms with the quantized electromagnetic field is expressed in terms of their multipole moments coupled to the electric and magnetic field strengths. The connection with the path-dependent electrodynamics of Mandelstam is clarified. Special attention is given to the problem of the center-of-mass motion of an atom interacting with the field. This is done by means of a canonical transformation, which has been used previously, in a specific or simplified form, for various aspects of the investigated problem. (auth)

13788 HIGHER-ORDER CORRECTIONS TO THE MOMENTUM-TRANSLATION APPROXIMATION. Choudhury, B.J. (Department of Physics, The University of Manitoba, Winnipeg, Canada). Phys. Rev. A 8: No. 4, 1759-1764 (Oct 1973).

A general analytical result has been obtained for the calculation of higher-order corrections to the momentum-translation approximation. Explicit analytical results are given for the calculation of higher-order corrections for bound-bound and bound-free transitions for hydrogenic atoms. Numerical results are given for 1S to 2S transitions in hydrogen. (auth)

13789 PHOTON WAVE FUNCTIONS AND THE EXACT ELECTROMAGNETIC MATRIX ELEMENTS FOR HYDROGENIC ATOMS. Moses, H.E. (Air Force Cambridge Research Laboratories, L. G. Hanscom Field, Bedford, Massachusetts 01730). Phys. Rev. A 8: No. 4, 1710-1721 (Oct 1973).

After reviewing the properties of the photon considered as a quantized particle of zero mass, positive energy, and unit spin, the expansion of the unquantized and quantized electromagnetic fields and vector and scalar potentials in terms of the photon wave functions and creation and destruction operators is reviewed and extended. The most general vector and scalar potentials are obtained through the use of the eigenfunctions of the curl operator. The dichotomy between the photon and wave picture of electromagnetic radiation is discussed and resolved. The results are applied to the calculation of the exact electromagnetic matrix elements and transition probabilities (i.e., with retardation taken into account exactly) for hydrogenic atoms. The exact matrix elements are very simple in form. The notion of multipole radiation of the usual treatments is irrelevant. However, it is shown how multipoles appear as an approximation. (auth)

13790 VARIATIONAL METHODS FOR MANY-BODY PROBLEMS. Rosenberg, L.; Tolchin, S. (Department of Physics, New York University, New York, New York, 10003). Phys. Rev. A 8: No. 4, 1702-1709 (Oct 1973).

A variational approach to the approximate solution of a wide variety of self-consistency problems is described. Attention is focused on the variational formulation of the nonlinear integral equation, which determines the single-particle Green's function of a many-particle system; such an equation arises from a particular truncation of the hierarchy of equations which dynamically couple the complete set of Green's functions. To illustrate the method, we have applied it, with encouraging results, to the numerical determination of the self-energy function for the helium atom in the Hartree-Fock approximation. The applicability of this approach to the general problem of electron-atom scattering is pointed out. (auth)

13791 UNIVERSAL APPROXIMATE ANALYTICAL SOLUTION OF THE THOMAS-FERMI EQUATION FOR IONS. Csavinszky, P. (Department of Physics, University of Maine, Orono, Maine 04473). Phys. Rev. A 8: No. 4, 1688-1701 (Oct 1973).

The great utility of the Thomas-Fermi (TF) theory of atoms lies in the fact that it gives a solution of the TF equation that is valid for all neutral atoms. In contrast to this situation, the TF equation for positive ions has to be solved separately for each degree of ionization of each atom. Using a previously obtained approximate analytical solution of the TF equation for neutral atoms (which is based on a variational principle), and a series-expansion approach (which relates the parameters in the ionic solution to those in the neutral-atom solution), the present paper derives a universal approximate analytical solution of the TF equation for ions. This solution, in addition to being valid for positive ions, is also applicable for negative ions for which the original TF theory does not furnish a solution. Furthermore, the approximate solution obtained here is not associated with finite ionic radii, and gives an exponentially decreasing radial electron density, which is not the case in the original TF theory. For this reason, the electron densities and potentials of ions that result from the present work are expected to be in better agreement with the quantum-mechanical data for these quantities than the electron densities and potentials obtained with the original TF theory. To show that this is so, the accuracy of the universal approximate analytical solution is investigated by calculating

the diamagnetic susceptibilities of singly and doubly charged positive and negative ions of noble-gas electron configurations. It is found that, in most cases, calculated and experimental values for ions of the Ar, Kr, and Xe electron configurations agree to within a factor of 2, while for ions of the Ne electron configuration the agreement is somewhat worse. This is about the same accuracy as that found using the Lenz-Jensen approximation to the TF theory which, like the universal approximation, also makes use of variational electron density but, unlike the universal approximation, has to be separately obtained for each particular ion. As a further check on the usefulness of the universal ionic solution, the diamagnetic susceptibilities of the isoelectronic ions Ga^{3+}, Ge^{4+}, and As^{5+} are also calculated and found to agree only slightly worse than within a factor of 2 with the experimental data. After further comparison with data obtained from more-refined statistical models, the conclusion is that the universal solution for ions may be useful in a variety of problems where quantum-mechanical accuracy may be traded for a simpler approach. (auth)

13792 LAMB SHIFT IN HELIUMLIKE IONS. Ermolaev, A.M. (Department of Physics and Astronomy, University College, London, England). Phys. Rev. A 8: No. 3, 1651-1657 (Sept 1973).

Estimates of the Lamb shift in bound states of two-electron ions reported by Kastner are discussed critically. A consistent treatment of the quantum-electrodynamical correction of order α^3 to the relativistic potentials of ionization of atoms with two electrons is developed and convenient expressions for these corrections in a $|nLSJ>$ state of the atom, are obtained. The numerical results are in close agreement with the experimental data of Edlén and Löfstrand for C V. (auth)

13793 TWO-PHOTON CORRELATIONS IN ATOMIC TRANSITIONS. Fry, E.S. (Department of Physics, Texas A&M University, College Station, Texas 77843). Phys. Rev. A 8: No. 3, 1219-1232 (Sept 1973).

A general formula is derived for two-photon coincidence rates. The result obtained is a function of the orientation of linear polarizers, of the solid angles subtended, and of the relative position of the photon detectors. It applies to both cascade emissions and resonance flourescence when the transitions are of electric dipole type. Allowance is made for anisotropic initial-state populations. It is shown that a single parameter describes the atomic transition when the initial states are isotropically populated. This parameter is found to have a particularly simple form, even when the nuclear spin is nonzero. It is the product of two Racah coefficients and an E coefficient defined here. Tables of the required Racah and E coefficients are provided so that this parameter can be easily determined when the states in the transitions have J values 0, 1, 2, 3, 4, (1/2), (3/2), (5/2), (7/2), or (9/2) and when the nuclear spin is 0, 1, (1/2), (3/2), (5/2), (7/2), or (9/2). Experiments to test hidden-variable theories which are possible in view of these results are discussed. Experiments to determine the effective quantum efficiency of photon detectors using these results are described. (auth)

13794 ADDITIVE NATURE OF CORRELATION AND RELATIVISTIC EFFECTS IN ATOMIC HYPERFINE STRUCTURE. Feneuille, S.; Armstrong, L. Jr. (Laboratoire Aime Cotton, Centre National de la Recherche Scientifique II, Orsay, 91-France). Phys. Rev. A 8: No. 3, 1173-1180 (Sept 1973).

In the calculation of atomic hyperfine structure, it is generally assumed that core polarization effects and relativistic effects can be calculated separately. We examine in detail the validity of this assumption and obtain the lowest-order corrections to such an approach. This correction is described by new operators to be added to the hyperfine Hamiltonian, as well as second-order perturbation terms. The systematic effects of the second-order terms are investigated using the effective-operator approach. (auth)

13795 SIMPLE ATOMIC MODEL AND ITS ASSOCIATED WAVE FUNCTION. Mueller, R.O.; Rau, A.R.P.; Spruch, L. (Department of Physics, New York University, New York, New York 10003). Phys. Rev. A 8: No. 3, 1186-1194 (Sept 1973).

A simple atomic model, with features characteristic of the screening-theory approach, is constructed and provides simple analytic trial wave functions ψ_l which describe the motion of the inner electrons particularly well. Basing our model on the energy-extremum principle, in contrast to a semiempirical or phenomenological approach, we can judge improvements in the model in a consistent manner. The single-particle orbitals from which ψ_l is contructed are taken to be orthogonal hydrogenlike functions with effective nuclear charges $\bar{Z}_l$ which depend on the quantum number l; the $\bar{Z}_l$ serve as variational parameters. By a succession of reasonably good upper bounds the evaluation of the expectation value of the $1/r_{ij}$ interelectronic terms is reduced to trivial algebraic expressions involving only the occupation number of electrons for each of the (n,l) subshells; no numerical work is necessary to determine the energy-optimized set of $\bar{Z}_l$. With the resulting ψ_l, which is most appropriate for closed-shell atoms, a variety of atomic entities can be obtained directly in analytic form. This model is considered physically more realistic than the Thomas-Fermi model, yielding results of greater accuracy in general. (For large Z, the results obtained yield the usual Thomas-Fermi scaling laws.) Much more importantly, these wave functions will be shown elsewhere to be very useful in exploratory analytic studies to judge the effectiveness of variational techniques in the evaluation of the expectation values of various atomic operators. Also, a straightforward adaptation of the present approach will be shown elsewhere to provide a much better understanding of atomic structure in the presence of the intense magnetic fields characteristic of pulsars, a regime in which studies of the heavier atoms have been limited to a statistical Thomas-Fermi-like approach. (auth)

13796 VIRIAL THEOREM IN ADIABATIC REPRESENTATION. Matveenko, A. V. (Joint Inst. for Nuclear Research, Dubna). J. Phys., B (London); 6: No. 11, L316-L318 (Nov 1973).

For any diatomic molecule three different virial theorems can be formulated. The most general one is independent of the problem and the representation. The other two stemmed out of adiabatic representation. The first of them is the well known electronic Slater's virial theorem. The virial theorem is derived from the Born-Oppenheimer type coupled nuclear equations. (auth)

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

Refer also to abstract 14715.

13797 MAGNETOHYDRODYNAMIC ENTRY FLOWS IN AXIAL MAGNETIC FIELDS. D'Arcy, G. P. Austin, TX; Univ. of Texas (1973). 189p. University Microfilms Order No. 73-25,992.

Thesis (Ph. D.).

The magnetohydrodynamic entry length for the flow of an electrically conducting liquid into plane channels and circular pipes is studied theoretically. In every case the applied magnetic field is aligned with the flow axis. All other induced magnetic fields are neglected. A parabolic distribution is used to describe the boundary layer velocity profile. This profile is used to generate an integral solution which is solved numerically. The resulting solutions show that axial magnetic fields will produce longer entry regions, bigger pressure drops, and measurable transverse pressure variations. They also show that both the channel and pipe solutions may be correlated by a single dimensionless parameter relating viscous, magnetic, and inertial forces. The prime motivation for this research comes from the need to specify the flow characteristics for a liquid metal coolant flowing through a fusion reactor blanket. The flow of such material will interact with the magnetic field which must exist to confine the reacting plasma. The application of the results of this analysis to several fusion reactor configurations indicates that the direct effect of the axial magnetic field on the total reactor pressure drop is slight. However, the corresponding increase in heat transfer within the extended entry region should result in substantially lower coolant velocities and a corresponding decrease in the total reactor pressure drop. (Diss. Abstr. Int., B)

13798 DEVELOPING VELOCITY PROFILES IN A MAGNETOHYDRODYNAMIC DUCT. Koegler, S.S.; Thomson, W.J. (University of Idaho, Moscow, Idaho 83843). Phys. Fluids 16: No. 9, 1534-1536 (Sept 1973).

A laser Doppler velocimeter is used to measure the velocities for a developing magnetohydrodynamic flow under laminar flow conditions. It is found that entrance effects propagate upstream and exert considerable influence on the distance required to attain fully developed flow. (auth)

13799 RECONNECTION OF MAGNETIC LINES OF FORCE. Fukao, S. (Kyoto Univ.); Tsuda, T. J. Plasma Phys.; 9: 409-427(Jun 1973).

The magnetic field and flow with an X-type neutral point or stagnation point are studied numerically for the steady state of incompressible, finitely conducting, viscous fluid in two dimensions. There appear two transition layers connecting smoothly the regions on either side, each of which contains almost uniform magnetic field and flow. The electric currents are concentrated in the vicinity of the neutral point and along the transition layers. The magnetic field is regarded as almost frozen in the fluid in other current-free regions, even in the case of moderate conductivities. The current-core over the neutral point is accompanied by a shear of currents, which may effectively contribute to reducing the local electrical conductivity. Thus the reconnection of magnetic lines of force may be possible even in very highly conducting fluids. It is shown that the re-connection is not essentially influenced by dissipation due to finite electrical conductivity or viscosity, but definitely by external conditions such as the applied electric field in the magnetic field and flow. (auth)

13800 COUPLED WAVES IN STRATIFIED HYDROMAGNETIC MEDIA. I. Burman, R. (Univ. of Western Australia, Nedlands). Czech. J. Phys.; 23: No. 11, 1209-1218(1973).

Linearized first-order coupled wave equations are derived which describe waves in horizontally stratified hydromagnetic media, with gravity allowed for. The cases considered are compressible media of finite scalar conductivity (for two special configurations of the magnetostatic field compressible media of infinite conductivity) and cold incompressible media. (auth)

13801 EXPERIMENTAL STUDY OF ALIGNED FIELD MAGNETOFLUID DYNAMIC FLOW. Pincosy, P. A. Seattle; Univ. of Washington (1973). 193p. University Microfilms Order No. 73-27,679.

Thesis (Ph. D.).

The behavior of the fluid flow and the magnetic field in a magneto-fluid dynamic flow was investigated experimentally. The most important result was the observation of the fast magneto-acoustic waves. The experimental study was performed using a shock tube where an ionized test gas was produced by a strong shock wave. An axial magnetic field was applied to the shock tube flow and the interaction was produced by a cone model. Xenon was used as the test gas. Typical values of the magnetic Reynolds number and the interaction parameter, for the xenon test gas with $P_1 = 1.0$ torr and $M_s = 15$, were 0.3 and 0.5 respectively. For the range of applied magnetic field (0.2 to 0.9 weber/m^2) the Alfven Mach number was variable from greater than to less than unity. (Diss. Abstr. Int., B)

13802 TWO-DIMENSIONAL STEADY MAGNETO-FLUID-DYNAMIC FLOWS WITH ORTHOGONAL MAGNETIC AND VELOCITY FIELD DISTRIBUTIONS. Chandna, O. P.; Nath, V. I. (Univ. of Windsor, Ont.). Can. J. Phys.; 51: No. 7, 772-778(1 Apr 1973).

The geometries of flows with constant speed along each individual streamline, sonic flows, and flows with isometric nets are determined. Study of two dynamically distinct flows having the same streamline pattern is made. Solutions for vortex, radial, and parallel flows are obtained. (auth)

13803 HYDROMAGNETIC STABILITY OF SPIRAL FLOWS WITH DENSITY STRATIFICATION. Sharma, G. C. Int. J. Eng. Sci.; 11: No. 3, 377-384(Mar 1973).

The hydromagnetic stability of spiral flow of conducting fluid in the presence of axial magnetic field and axial currents with an external gravitational force varying inversely with radius is investigated with axisymmetric perturbation. Among the main assumptions, it should first be pointed out, is that the magnetic Reynolds number ($R_H = VL/\eta$, where η is the magnetic diffusivity, and V and L are the characteristic velocity and length of the flow respectively) is greater than unity. In discussing stability in general, it is proven that a density decreasing with the radius or a gravity field towards the center of rotation has a stabilizing effect on the flow. This conclusion is supported by the theory of vortex formation. The sufficient condition for stability is fully exploited for different situations. In this model, the requirement of completely stabilized flow for all wave numbers is established as a theorem with two corollaries. For the case without axial flow, the sufficient condition of stability is simplified to the general rule of Kelvin–Helmholtz stability, i.e., the Richardson number should be greater than $\frac{1}{4}$. The complex velocity of unstable mode is limited to circles defined by the velocities and the Richardson number. In the case of flow without axial magnetic field, another set of stable conditions is found. (Appl. Mech Rev.)

PHYSICS (HIGH-ENERGY)

13804 (CERN-73-12) PROCEEDINGS OF THE 1973 CERN-JINR SCHOOL OF PHYSICS, EBELTOFT, DENMARK, JUNE 17-30, 1973. Kofoed-Hansen, O. (ed.). (European Organization for Nuclear Research, Geneva (Switzerland)). 24 Sep 1973. 369p. Dep. NTIS (U. S. Sales Only) $20.50.

The Proceedings contain notes of the main lecture courses by Jacob, Kajantie, Koba, and Muradyan, as well as Part I of the course by Matveev. A separate abstract is prepared for each lecture. (LBS)

For abstracts of individual papers see: 13907-13911.

Particle Interactions and Properties (Experimental)

Refer also to abstract 14278.

13805 HIGH ENERGY PHYSICS INDEX. Volume 11, No. 25, 1973. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1973). 87p.

Electromagnetic

Refer also to abstracts 12821 and 12908.

13806 (COO-1112-186) PRECISION MEASUREMENT OF THE MAGNETIC MOMENT OF THE PROTON IN NUCLEAR MAGNETONS AND THE MASS DIFFERENCE OF THE DOUBLET H_2^+-D^+. Luxon, J. L. (Michigan Univ., Ann Arbor (USA). Dept. of Physics). Aug 1972. 215p. Dep. NTIS $12.75.

Thesis.

The results of the application of a new technique for observing ion cyclotron resonance for the measurement of the magnetic moment of the proton in nuclear magnetons μ_p/μ_n and the mass difference of the $H_2^+ - D^+$ doublet are reported. The preliminary results give $\mu_p/\mu_n = 2.792\,786 \pm 0.000\,017$ (6.0 ppm) for protons in a spherical water sample and $H_2^+ - D^+ = 1548.22 \pm 0.20$ $\mu\mu$. (JFP)

13807 (IKDA-73-6, pp 22-23) MEASUREMENT OF $(\mu G_E G_M)_p$ FOR VERY SMALL q^2. Theissen, H.; Schuetz, W. Jul 1973. (In German).

In progress report, 1971-1972.

13808 (N-73-15723) MEASUREMENTS OF ELECTRON-BREMSSTRAHLUNG COINCIDENCE RATES AT INTERMEDIATE ELECTRON ENERGIES. Final Report, 1 November 1971-1 November 1972. Rester, D. H. (Advanced Technology Center, Inc., Arlington, Tex. (USA)). Oct 1972. Contract NAS8-27866. 34p. (NASA-CR-124007). NTIS $3.75.

Coincidence rates were measured for inelastically scattered electrons and their associated bremsstrahlung for bombarding energies of 0.20 and 0.15 MeV. Measurements were made for an electron angle of 45 deg and a photon angle of 20 deg. Inelastic electron energies of 0.15 and 0.16 MeV were considered for an incident energy of 0.2 MeV and an inelastic electron energy of 0.12 MeV was considered for an incident energy of 0.15 MeV. To observe the trend with atomic number, Al and Au targets were used. The experimental cross section differentials in photon and electron angles and energy were found to be smaller than the predictions of the Bethe-Heitler theory. (auth)

13809 MEASUREMENT OF π^0 ELECTROPRODUCTION ON HYDROGEN NEAR THRESHOLD. Botterill, D. R. (Daresbury Nuclear Physics Lab., Eng.); Braben, D. W.; Norton, P. R.; Del Guerra, A.; Giazotto, A.; Giorgi, M. A.; Stefanisi, A. Lett. Nuovo Cim.; 8: No. 15, 910-914(8 Dec 1973).

The total cross section for $ep \rightarrow ep\pi^0$ at momentum transfers $|-K^2| = 0.155$, 0.233, and 0.311 $(GeV/c)^2$ was deduced by subtracting from the single-arm cross section the measured $ep \rightarrow en\pi^+$ cross section and the radiative tail $ep \rightarrow ep\gamma$. (LBS)

13810 PHOTOPRODUCTION OF SINGLE η-MESONS ON NUCLEI AT $E_\gamma = 2$ GeV. Abramyan, L. O.; Agan'yants, A. O.; Adamyan, F. V.; Vartapetyan, G. S.; Vat'yan, A. L.; Gevorkyan, S. R.; Demekhina, N. A.; Israelyan, M. Kh.; Kazaryan, G. Kh.; Lebedev, A. N.; Manukyan, Zh. V.; Muradyan, E. G.; Philiposyan, S. E.; Sirunyan, A. M.; Khudaverdyan, A. G.; Khurshudyan, L. S. Yadern. Fiz.; 18: No. 4, 817-824(Oct 1973). (In Russian).

The reaction $\gamma A \rightarrow \eta A'$ on the nuclei Be, C, Al, Cu, Ag, Pb was studied at $E_\gamma = 2$ GeV and $|t| = 0.5$ $(GeV/c)^2$. The η-meson was detected by γ-quanta using two Cherenkov total absorption counters. The theoretical and experimental values of $A_{\eta\pi}$ were compared to obtain the total meson-nucleon interaction cross section $\sigma_{\eta N}$ at $p_\eta = 1.65$ GeV/c. The extracted value of the cross section $\sigma_{\eta N}$ depends on the ratio R of the η-meson photoproduction cross sections on a proton and a neutron. For the value $R = 0.30 \pm 0.60$ the cross section $\sigma_{\eta N}$ agrees within the errors with the theoretical value $\sigma_{\eta N} = 20$ mb obtained in the quark theory. (auth)

13811 TWO-PHOTON PROCESSES FOR PARTICLE PRODUCTION AT HIGH ENERGIES. Terazawa, H. (The Rockefeller University, New York, New York 10021). Rev. Mod. Phys. 45: No. 4, 615-662 (Oct 1973).

The literature of the past three years on the two-photon process for particle production $e^+ + e^- \rightarrow e^+ + \gamma^* + e^- + \gamma^* \rightarrow e^+ + e^- + X$ (where X is any C = + state) or $p + p \rightarrow X_1 + \gamma^* + X_2 + \gamma^* \rightarrow X_1 + X_2 + \mu^+ + \mu^-$ (where X_1,X_2 are hadron states) is reviewed in some detail. Both the theoretical aspects and the experimental feasibility of various processes are discussed especially for experimentalists' convenience. (auth)

Weak

Refer also to abstracts 12940-12942, 13307, 13309, and 13741.

13812 (COO-2232-17-Ex) MUON TRIDENT DIRECT PAIR PRODUCTION AND OTHER PROBES OF THE MUON-MUON INTERACTION. Tannenbaum, M. J. (Rockefeller Univ., New York (USA)). 1972. Contract AT(11-1)-2232. 60p. (CONF-7209104-1). Dep. NTIS $5.00.

From seminar on the u-e problem; Moscow, USSR (19 Sep 1972).

A review is given of experimental studies on muon interactions, with special emphasis given to muon trident production. Some results are given on photo-pair production, muon-electron scattering, muon-proton scattering, and electron-positron annihilation yielding muon pair. (LBS)

13813 (JINR-P2-7348) POSSIBILITY OF SUPPRESSING THE BACKGROUND FROM $K \rightarrow l\nu\pi^0 \rightarrow l\nu\gamma e^+e^-$ DURING INVESTIGATION OF THE DECAY $K \rightarrow l\nu e^+e^-$. Bardin, D. Yu.; Mitsel'makher, G. V.; Shumeiko, N. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 16p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

A kinematic analysis of the decay $K \rightarrow l\nu_l e^+e^-$ and background process $K \rightarrow l\nu_l\pi^0$, $\pi^0 \rightarrow \gamma + e^+e^-$ was made. The experimental suppression of the background level is considered possible. Calculations were performed showing that the ratio of background/effect can be made sufficiently small. (tr-auth)

13814 (JINR-P14-7213) NEGATIVE MUON DEPOLARIZATION IN CONDENSED MOLECULAR MEDIA. Dzhuraev, A. A.; Evseev, V. S.; Obukhov, Yu. V.; Roganov, V. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 16p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.00.

The asymmetry coefficients of μ-e-decay electrons in aqueous solutions of hydrogen peroxide of different concentration are measured at room temperature by the precession method. The asymmetry coefficient is measured for 97% (on weight) solution of hydrogen peroxide at 80°K; the value of rate of chemical reactions of mesic nitrogen is determined. It is shown that temperature dependence for the high concentrated solution is more mildly sloping than for the 7.5% solution. This fact is explained by the presence of activation energy in the chemical reaction of mesic nitrogen with hydrogen peroxide molecules. The value of the residual polarization of muons in styrene, at temperatures higher and lower than the phase transition point, is shown practically to be unchangeable and the ratio of these values is 0.93 ± 0.08. The polarization ratio is measured for 300 and 80°K to be $(a/a_c)300°/(a/a_c)80°$ for polystyrene (1.33 ± 0.31), for poly(butyl methacrylate) (1.57 ± 0.13) and for H-butyl alcohol (2.7 ± 0.4). (auth)

13815 (LBL-2184) POSITIVE MUONS IN CONDENSED MEDIA. Schenck, A.; Crowe, K. M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1973. Contract W-7405-eng-48. 123p. (CONF-730471-2). Dep. NTIS $8.25.

From intermediate energy physics meeting; Zuoz, Switzerland (13 Apr 1973).

An account is given of three lectures given at The Topical Meeting on Intermediate Energy Physics, April 1973, at Zuoz, Switzerland, in which a broad picture was presented of positive muons used as probes in condensed matter physics and chemistry. The relevant properties of μ^+ are given, the preparation of the polarized μ^+ beam is described, and there is a discussion of the experimental set-ups.

The formation of muonium during the slowing down of μ^+ in matter is treated, and some related early measurements discussed. The quasi-free μ^+ precession and the possible depolarization affecting it in solid and liquid media are examined. Muonium, its quasi-free evolution, and its chemical reactions are covered, with emphasis on solid insulator and semiconductor environments. Finally, the use of μ^+ as a probe in matter is compared with other more conventional methods. (auth)

13816 (LBL-2407) REVIEW OF K^0 DECAYS. Nygren, D. R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1973. Contract W-7405-eng-48. 30p. (CONF-730837-10). Dep. NTIS $3.50.

From meeting of the division of particles and fields; Berkeley, California, USA (13 Aug 1973).

A review is given of selected topics in K^0 decays for which recent results have led to substantial progress and/or controversy. (auth)

13817 (UCI-10-P-19-79) RESEARCH PROGRAM IN NEUTRINO PHYSICS, COSMIC RAYS, AND ELEMENTARY PARTICLES. Progress Report, 1 October 1972–30 September 1973. Reines, F. (California Univ., Irvine (USA)). Sep 1973. Contract AT(11-1)-Gen-10. 72p. Dep. NTIS $5.75.

The research being conducted under this contract is centered on neutrinos at reactors and in the cosmic rays and cosmic ray muons. In addition, continuation in development of equipment for the study of double beta decay, a possible improved tachyon search, and instrumentation for ultra low background studies including an improvement (lowering) of extraterrestrial $\bar{\nu}_e$ flux limits and baryon conservation tests was accomplished. Also new ideas are reported regarding an experimental test for the existence of an advanced potential in electromagnetic radiation and a study of the muon decay spectrum. The suspension of work on the cosmic ray muon facility is discussed. The elastic scattering detector at Savannah River has produced much improved results. For the first time, the uncertainty in the result is less than the central value ^{c}expt'l/^{p}V-A = 1.1 ± 0.8, where $\sigma_{V-A} \simeq 5 \times 10^{-47}$ cm^2/fission $\bar{\nu}_e$. A major effort is underway to reduce the natural radioactivity believed to be responsible for most of the background which at present limits the accuracy of the experiment to ~ ±0.6. (auth)

13818 LOWER BOUND ON INTERMEDIATE-BOSON MASS. Barish, B.C.; Bartlett, J.F.; Buchholz, D.; Humphrey, T.; Merritt, F.S.; Nagashima, Y.; Sciulli, F.J.; Shields, D.; Suter, H. (California Institute of Technology, Pasadena, California, 91109); Krafczyk, G.; Maschke, A. Phys. Rev. Lett. 31: No. 3, 180-183 (16 July 1973).

We report a search for the W boson via the production process $\nu_\mu + Z \to W^+ + \mu^- + Z$ and decay process $W^+ \to \mu^+ + \nu_\mu$. We have set a firm lower bound on the mass of the W boson as a function of the branching fraction into leptons [B = (W→l+ν)/(W→all)]. For example, we have determined that $M_W > 4.4$ GeV/c^2 (90% confidence limit) for B=0.5. (auth)

13819 MEASUREMENT OF THE FORM FACTORS IN THE DECAY $K_L^0 \to \pi\mu\nu$. Donaldson, G.; Fryberger, D.; Hitlin, D.; Liu, J.; Meyer, B.; Piccioni, R.; Rothenberg, A.; Uggla, D.; Wojcicki, S. (Physics Department and Stanford Linear Accelerator Center, Stanford University, Stanford, California, 94305); Dorfan, D. Phys. Rev. Lett. 31: No. 5, 337-340 (30 July 1973).

A Dalitz plot of $1.6 \times 10^6 K_L^0 \to \pi\mu\nu$ decays has been studied to measure the t dependence of the vector and scalar form factors. The observed slopes, $\lambda_+ = 0.030 \pm 0.003$ and $\lambda_0 = 0.020 \pm 0.003$, are compatible with current-algebra and soft-pion predictions, μ–e universality, and K*(890) dominance of the vector form factor. (auth)

13820 MEASUREMENT OF THE BRANCHING RATIO AND π^0 ENERGY SPECTRUM FOR $K_L^0 \to \pi^+\pi^-\pi^0$. Alexander, G. (Tel Aviv Univ., Israel); Benary, O.; Borowitz, I.; Lande, K.; Oren, Y.; Stumer, I.; Burkhardt, E.; Filthuth, H.; Putzer, A.; Barnir, I. Nucl. Phys.; B65: No. 2, 301-306(1973).

The $K_L^0 \to \pi^+\pi^-\pi^0$ decay was studied in a bubble chamber experiment at an average momentum of 1.3 GeV/c. The branching ratio $\Gamma(K_L^0 \to \pi^+\pi^-\pi^0)/\Gamma(K_L^0 \to \text{charged})$ to be 0.1605 ± 0.0038 was measured. The data are well fitted with a linear matrix element in the π^0 kinetic energy with a slope g = 0.612 ± 0.032. (auth)

13821 SEARCH FOR A NEW VECTOR MESON IN K_L^0 DECAYS. Vovenko, A. S.; Voruba, Ya.; Gladki, Ya.; Kish, D.; Krivokhizhin, V. G.; Likhachev, M. F.; Nad, E.; Novak, M.; Prokesh, A.; Savin, I. A.; Urban, L. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern, Fiz.; 18: No. 4, 825-828 (Oct 1973). (In Russian).

There is no evidence of the new vector meson χ^0 produced in decays $K_L^0 \to \chi^0\gamma$. An upper limit for the ratio $\Gamma(K_L^0 \to \chi^0\gamma \to \mu^-\mu^+\gamma)/\Gamma(K_L^0 \to \text{all}) \leq 8.10^{-5}$ is obtained with 90% confidence level. (auth)

13822 NEW DETERMINATION OF THE Λ^0 MEAN LIFE. Althoff, K. H.; Brown, R. M.; Freytag, D.; Heard, K. S.; Heintze, J.; Mundhenke, R.; Rieselberg, H.; Soergel, V.; Stelzerc, H.; Wagner, A. (CERN, Geneva). Nucl. Phys.; B66: 29-35(1973).

From 6582 kinematically-reconstructed $\Lambda^0 \to p\pi$ decays observed in an optical spark chamber, the Λ^0 lifetime was evaluated to be $\tau_\Lambda = (2.69 \pm 0.05) \times 10^{-10}$ sec. This value is a factor of 1.067 ± 0.020 higher than the present world average. (auth)

Strong (Baryon-induced)

Refer also to abstracts 12896, 12907, 13739, 13946, and 13954.

13823 (BNL-18335, pp 92-105) RECENT EXPERIMENTAL TRENDS IN HYPERNUCLEAR PHYSICS. Povh, B. (CERN, Heidelberg). 1973.

From conference on nuclear and hypernuclear physics with kaon beams; Upton, New York (2 Jul 1973).

In proceedings of the summer study meeting on nuclear and hypernuclear physics with kaon beams.

The experimental requirements of hypernuclear spectroscopy are discussed. The similarity of the experimental methods in the hypernuclear and high energy nuclear physics is pointed out. (JFP)

13824 (BNL-18335, pp 106-130) PRELIMINARY RESULTS OF AN EXPERIMENTAL INVESTIGATION OF HYPERNUCLEAR SPECTRA USING COUNTERS TO MEASURE PION SPECTRA FROM THE REACTION $K^- + {}^AZ \to {}^AZ^* + \pi^-$. Bonazzola, G. C.; Bressani, T.; Cester, R.; Chiavassa, E.; Dellacasou, G.; Fainberg, A.; Freschi, D.; Mirfakhrai, N.; Musso, A.; Rinaudo, G. (Univ., Turin). 1973.

From conference on nuclear and hypernuclear physics with kaon beams; Upton, New York (2 Jul 1973).

In proceedings of the summer study meeting on nuclear and hypernuclear physics with kaon beams.

Preliminary results for K^- reactions with carbon-12 and oxygen-16 yielding ${}_\Lambda C^{12}$ and ${}_\Lambda O^{16}$ at 390 MeV/c are given. Differential cross sections for the production of the ground and 10-MeV excited states of ${}_\Lambda C^{12}$ and levels of ${}_\Lambda O^{16}$ are found. (JFP)

13825 (BNL-18335, pp 296-306) $K^- + d$ RADIATIVE CAPTURE AND THE Λ-n SCATTERING LENGTH. Gibson, B. F. (Los Alamos Scientific Lab., NM); Stephenson, G. J. Jr.; Brown, V. R.; Weiss, M. S. 1973.

From conference on nuclear and hypernuclear physics with kaon beams; Upton, New York (2 Jul 1973).

In proceedings of the summer study meeting on nuclear and hypernuclear physics with kaon beams.

Photon spectra for the $K^- + d \to \Lambda + n + \gamma$ reaction at 265 to 293 MeV are studied in order to determine with scattering length and effective range parameters for the $\Lambda + n$ interaction. (JFP)

13826 (COO-1428-332) P–P AND P–D ELASTIC AND INELASTIC SCATTERING IN THE HIGH T-REGION IN THE NEW INTERNAL TARGET LABORATORY. Bartenev, V.; Kuznetsov, A.; Morozov, B.; Nikitin, V.; Pilipenko, Y.; Zolin, L.; Malamud, E.; Yamada, R.; Loeffler, F.; Shibata, E.; Stanfield, K.; Tang, Y. (Purdue Univ., Lafayette, Ind. (USA). Dept. of Physics). 1973. 35p. Dep. NTIS $3.75.

An experiment is proposed to measure p–p and p–d elastic and inelastic scattering in the high t-region in the new B-O Internal Target Laboratory. These measurements will continuously cover incident beam energies from 30 to 500 GeV. The t-region is covered from 0.2 up to at least 10 (GeV/c)^2 for p–p elastic scattering and up to 5 (GeV/c)^2 for p–d elastic scattering; it can be extended with future modifications. Magnetic spectrometers will be used to measure the angles and momenta of the recoil particle and the forward scattered particle. (auth)

13827 (COO-3065-60) STUDY OF pp INTERACTIONS AT 102 AND 405 GeV/c. Cohen, D. (Rochester Univ., N. Y. (USA). Dept. of Physics and Astronomy). 31 Oct 1973. Contract AT(11-1)-3065. 35p. (CONF-730976-1; UR-461). Dep. NTIS $3.75.

From fourth international symposium on multiparticle hadrodynamics; Pavia, Italy (Sep 1973).

An analysis is made of ~5000 pp interactions at 102 GeV/c and ~2500 pp interactions at 405 GeV/c from exposures of the NAL 30-inch hydrogen bubble chamber. Results are presented and discussed on the charged-particle multiplicity distribution, the diffractive component in pp collisions, and inclusive pion production and charged-particle correlations. (LBS)

13828 (IFVE-SEF-73-52) NEGATIVE PION CHARGE EXCHANGE SCATTERING ON PROTONS IN THE MOMENTUM RANGE 20 TO 50 GeV/c. Bolotov, V. N.; Isakov, V. V.; Kakauridze, D. B.; Kachanov, V. A.; Kut'in, V. M.; Prokoshkin, Yu. D.; Razuvaev, E. A.; Semenov, V. K.; Sen'ko, V. A.; Rybakov,

V. G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1973. 39p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.00.

Differential cross sections for $\pi^- p \to \pi^0 n$ reaction were measured in the momentum range up to 50 GeV/c. The energy dependence of cross sections is of the power form. The forward scattering cone shrinks with the energy growth. The cross section for charge exchange at zero angle changes with momentum as $p^{-0.81\pm0.05}$. The charge exchange cross section in the region of the second maxima decreases as $p^{-2.8\pm0.1}$. ρ-trajectory is described with a linear function $\alpha(t) = 0.56 + 0.97t$ in the interval $0 < -t < 1.5$ (GeV/c)^2. (auth)

13829 CORRELATION OF PARTICLES AT 200 GeV/c PROTON–PROTON INTERACTION. Jain, P. L.; Kazuno, M.; Ahmad, Z.; Girard, B.; Thomas, G.; Moses, G. (State Univ. of New York, Buffalo). Lett. Nuovo Cim.; 8: No. 16, 921-928 (15 Dec 1973).

Particle production by 200 GeV/c protons interacting with a proton in nuclear emulsions was studied, and results are presented on the secondaries of the white stars whose space angles were measured with respect to the primary beam. Single-particle rapidity distributions and two-particle correlations are presented and discussed. (LBS)

13830 INTRODUCTION TO PROTON–PROTON COLLISIONS AT HIGH ENERGIES. Schmitz, N. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Acta Phys. Pol.; B4: No. 6, 689-768(1973).

The experimental data on topological cross sections, single particle distributions and correlations observed in proton–proton collisions at high energies are discussed in the framework of multiperipheral and fragmentation pictures. (auth)

13831 PARTICLE PRODUCTION AT THE ISR. Lillethun, E. (Univ. of Bergen). Acta Phys. Pol.; B4: No. 6, 769-803(1973).

A review is given of the most recent data on particle production (mostly single particle inclusive production) at the CERN Intersecting Storage Rings. Discussed are total cross sections, elastic cross sections production of π^+, K^+ and p^+ in the forward direction and in the large angle region, production of particles with large transverse momentum. (auth)

13832 DIFFRACTION SCATTERING OF DEUTERONS WITH 2.45 GeV/c MOMENTUM IN NUCLEAR PHOTOEMULSION. Karaba, J.; Tucek, J.; Karabova, M. (Safarik Univ., Kosice, Poland). Fyz. Cas.; 22: No. 1-2, 77-87(1972).

Basic experimental data on the primary beam and cases of elastic scattering were obtained by measuring multiple scattering and ionization. After a correction for Coulomb scattering the cross section was obtained of the diffraction scattering of deuterons on the nuclei of photographic emulsion $\delta_{el} = 792^{+10}_{-8}$ m barn. Reducing this value for 1 nucleon yields the value δ_{el}/nucl = 64 ± 7m barn. The values of the differential cross sections obtained experimentally were compared with the square amplitude of diffraction scattering $|fd|^2$. A good agreement of the theoretical and experimental data can be seen in the region of very small angles. (Nucl. Sci. Abstr. Czech.)

13833 ELASTIC SCATTERING OF 1-GeV PROTONS BY ^{39}K AND ^{40}Ca NUCLEI. Alkhazov, G. D.; Amal'skii, G. M.; Belostotskii, S. L.; Vorob'ev, A. A.; Grachev, V. T.; Domchenkov, O. A.; Dotsenko, Yu. V.; Starodubskii, V. E.; Shuvaev, M. A. (Leningrad Inst. of Nuclear Physics). JETP Lett. (USSR) (Engl. Transl.); 18: No. 5, 181-182(5 Sep 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 5, 309-312(5 Sep 1973).

The differential cross section for elastic scattering of 1-GeV protons by ^{39}K and ^{40}Ca nuclei in the angle interval θ_{cms} = 5 to 18°. An analysis within the framework of the Glauber theory with a single-particle nuclear density describes the experimental results adequately. (auth)

13834 ABC AND DEF EFFECTS IN THE REACTION d + p → ^{3}He + (mm)^0: POSITION, WIDTH, ISOSPIN, ANGULAR AND ENERGY DISTRIBUTIONS. Banaigs, J. (CNRS, Saclay, France); Berger, J.; Goldzahl, L.; Risser, T.; Vu-Hai, L.; Cottereau, M.; Le Brun, C. Nucl. Phys.; B67: No. 1, 1-36(1973).

The spectrum of mesonic missing mass produced in the reaction (1) d + p → ^{3}He + (mm)^0 was studied with a beam of deuterons extracted from the Saclay synchrotron Saturne. Thirteen spectra in the range of incident moments 2.8 < p < 3.8 GeV/c were taken of reaction (1) as well as two spectra of the conjugate reaction (2) d + p → ^{3}H + (mm)$^+$ where the missing mass is in a pure state of isospin, I = 1, whereas one can have I = 1 or I = 0 in (1). The results obtained permit us: (a) To confirm the existence and the isospin, I = 0, of the "ABC" effect in reaction (1); (b) To observe that the central mass of the "ABC" effect varies somewhat with kinematical conditions, the extremes being 300 ± 12 and 365 ± 23 MeV; (c) To obtain the angular distribution of the ^{3}He associated with the production of the "ABC". This distribution, strongly peaked forward and backward in the center of mass system, differs from the angular distributions corresponding to π^0 and η^0 production; (d) To observe that the production cross section of the "ABC" varies rapidly with total energy in the center of mass and has a maximum around W* = 3.38 GeV; (e) To produce evidence for a new effect, named here the "DEF" effect, in the neighborhood of 450 ± 20 MeV and to assign isospin I = 0 to this effect; (f) To show that the production cross section of the "DEF" has the same angular and energetic characteristics as the "ABC"; (g) To observe, around the maximum observable missing mass, an important enhancement. (auth)

13835 LANDOLT-BOERNSTEIN. Numerical Data and Functional Relationships in Science and Technology. New Series. Group I. Nuclear and Particle Physics. Volume 7. Elastic and Charge Exchange Scattering of Elementary Particles. Carlson, P. J.; Diddens, A. N.; Giacomelli, G.; Moennig, F.; Schopper, H. Berlin; Springer–Verlag (1973). 550p. (In German and English). $139.40.

The tables presented cover cross sections and polarization for nucleon–nucleon scattering, K–nucleon elastic and charge-exchange scattering, and $\pi^+ + p$ and $\pi^- + p$ elastic and charge-exchange scattering. (JFP)

13836 DETERMINATION OF INELASTIC INTERACTION CROSS SECTION OF NUCLEONS IN IRON IN 1 TEV ENERGY REGION. Zazyan, M. Z.; Mamidzhanyan, E. A.; Martirosov, R. M. (Erevan State Univ.). Izv. Akad. Nauk Arm. SSR, Ser. Fiz.; R8: No. 1, 73-75(1973). (In UR).

The interaction path of nucleons in iron in the 0.6 to 10 TeV energy region was measured by two independent methods. The obtained value of the path, L_{inc}, is equal to (146 ± 17) g/sm^2. This value corresponds to the cross section of inelastic interactions σ in Fe = (640 ± 74) mb. (auth)

13837 STUDY OF SMALL COMPONENTS OF WAVE FUNCTIONS OF FEW-NUCLEON SYSTEMS. Shannon, D. L. Los Angeles; Univ. of California (1973). 151p. University Microfilms Order No. 73-28,975.

Thesis (Ph. D.).

The primary objective is the determination of the percentage admixture of some of the small components of the wave functions of certain few-nucleon systems. Specifically: Experimental data on the reaction d(p,2p)n were taken at E_{inc} = 45 MeV, in both coplanar and noncoplanar configurations, for kinematical situations as remote as possible from dominant 2-body effect regions (i.e., quasifree and final state interaction peaks). The aim was to try to detect enhancements in the breakup cross sections arising from the contribution of the deuteron D-state (which could peak somewhere in the region p_n = 70 to 100 MeV/c). Unfortunately, it is virtually impossible to obtain the correct kinematical conditions in a coplanar configuration and, therefore, any possible D-state contribution in this case is buried by the highly dominant 2-body effects. The problem with the noncoplanar configurations is the very small cross sections which require much experimental time to acquire statistically accurate data. Significantly, both the coplanar and the noncoplanar data are fit extremely well both in shape and in magnitude by an Amado-type calculation assuming a simple S-wave interaction. The ratios of d/d* from ^{3}He(p,2p) data at E_{inc} = 35, 45 and 155 MeV for various (coplanar) angular configurations are used in an effort to calculate the percentage of mixed symmetry S-state (S') component in the wave function of the ^{3}He nucleus. A variational calculation fitting the charge form factor and the binding energy with the usual accuracy (i.e., the second maximum of the charge form factor is too low and the binding energy is 4 to 6 MeV–depending on the wave function used) estimates the S' probability at 0.2 or 0.65% (also depending on which wave function), but the fits to the ^{3}He(p,2p) data indicate that it might be somewhat higher (even as much as ~4%). The secondary objective is to analyze break-up data on the reaction ^{3}He + ^{3}H at E_{inc} (^{3}He) = 50 MeV (taken at NRL in Washington, D. C.) in the context of the quasifree scattering or quasifree reaction model and, thus, to demonstrate the effectiveness of the model. The quasifree model is shown to be an extremely useful model. (Diss. Abstr. Int., B)

Strong (Meson-induced)

Refer also to abstract 12913.

13838 (COO-1195-271) DECAY CHANNEL $A_2^- \to \eta\pi^-$ IN THE REACTION $\pi^- p \to p\pi^-\pi^+\pi^-\pi^0$ AT 40 GeV/c. Antipov, Yu. M.; Ascoli, G.; Busnello, R.; Kienzle–Focacci, M. N.; Kienzle, W.; Klanner, R.; Landsberg, L. G.; Lebedev, A. A.; Lechanoine, C.;

Lecomte, P.; Martin, M.; Roinishvili, V.; Weitsch, A.; Yotch, F. A. (Illinois Univ., Urbana (USA). Dept. of Physics). 1973. Contract AT(11-1)-1195. 12p. (CONF-730943-4). Dep. NTIS $3.00.

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

The branching ratio $A_2^- \to \eta\pi^-/A_2^- \to \rho\pi = 0.22 \pm 0.03$ (statistical error; systematic error ± 0.02) was measured at 40 GeV/c. From an analysis of the decay angular distribution a $J^P = 2^+$ wave in a pure $|M| = 1$ state, produced by natural parity exchange was obtained. (auth)

13839 (COO-1195-272) DIFFERENTIAL CROSS SECTIONS AND SCALING IN $\pi^-p \to X^-p$ AT 25 AND 40 GeV/c. Antipov, Yu. M.; Busnello, R.; Kienzle-Focacci, M. N.; Kienzle, W.; Klanner, R.; Landsberg, L. G.; Lebedev, A. A.; Lecomte, P.; Roinishvili, V.; Sard, R. D.; Weitsch, A.; Yotch, F. A. (Illinois Univ., Urbana (USA). Dept. of Physics). 1973. Contract AT (11-1)-1195. 11p. (CONF-730943-5). Dep. NTIS $3.00.

From second international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

The reaction $\pi^-p \to X^-p$ was investigated at $p_{inc} = 25$ and 40 GeV/c at the Serpukhov Accelerator. The differential inelastic cross sections $\Delta^2\sigma/\Delta t\Delta M^2$ are presented as a function of s, t, and M^2 (X^-). The scaling hypothesis was tested. (auth)

13840 (COO-1195-273) A_1, A_2, AND A_3 PRODUCTION IN $\pi^-p \to n\ \pi^-\pi^+p$ AT 25 AND 40 GeV/c. Antipov, Yu. M.; Ascoli, G.; Busnello, R.; Kienzle-Focacci, M. N.; Kienzle, W.; Klanner, R.; Lebedev, A. A.; Lecomte, P.; Roinishvili, V.; Weitsch, A.; Yotch, F. A. (Illinois Univ., Urbana (USA). Dept. of Physics). 1973. Contract AT(11-1)-1195. 37p. (CONF-730943-6). Dep. NTIS $4.00.

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

A sample of ~70,000 fitted events of the reaction $\pi^-p \to \pi^-\pi^-\pi^+p$ at 25 and 40 GeV/c was obtained with the CERN-IHEP Boson Spectrometer at the Serpukhov Accelerator. A partial-wave analysis shows that: A_1 and A_3 cannot be described by a Breit-Wigner amplitude; the A_2 can be well described by a Breit-Wigner amplitude; although A_1, A_3, and A_2 have different properties, the energy dependence of their production cross section is similar. (auth)

13841 (COO-1195-274) REACTION $K^-p \to X^-_Kp$ AT 25 AND 40 GeV/c. Antipov, Yu. M.; Busnello, R.; Kienzle-Focacci, M. N.; Kienzle, W.; Klanner, R.; Landsberg, L. G.; Lebedev, A. A.; Lecomte, P.; Roinishvili, V.; Sard, R. D.; Weitsch, A.; Yotch, F. A. (Illinois Univ., Urbana (USA). Dept. of Physics). 1973. 11p. (CONF-730943-7). Dep. NTIS $3.00.

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

The reaction $K^-p \to X^-_Kp$ was investigated at $p_{inc} = 25$ and 40 GeV/c using the CERN-IHEP Boson Spectrometer at the Serpukhov Accelerator. Missing-mass spectra and differential inelastic cross sections $\Delta^2\sigma/\Delta t\Delta M^2$ are presented as a function of s, t, and M^2 (X^-_K). (auth)

13842 (COO-1195-275) PRODUCTION OF $K^{*-}(890)$ AND $K^{*-}(1420)$ IN THE REACTION $K^-p \to (K\pi)^-p$ AT 25 AND 40 GeV/c. Antipov, Yu. M.; Ascoli, G.; Busnello, R.; Kienzle-Focacci, M. N.; Kienzle, W.; Klanner, R.; Landsberg, L. G.; Lebedev, A. A.; Lecomte, P.; Roinishvili, V.; Weitsch, A.; Yotch, F. A. (Illinois Univ., Urbana (USA). Dept. of Physics). 1973. 14p. (CONF-730943-8). Dep. NTIS $3.00.

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

The reaction $K^-p \to X^-_Kp$ was measured at 25 and 40 GeV/c at the Serpukhov accelerator using the CERN-IHEP Boson Spectrometer. At both energies production of the resonances $K^{*-}(890)$ and $K^{*-}(1420)$ were observed in the channels $K^{*-} \to K^0\pi^-$ and $K^-\pi^0$; the momentum dependence of their production cross sections is found to be $\sigma[K^{*-}(890)] \propto p_{inc}^{-1.48\pm0.04}$ and $\sigma[K^{*-}(1420)] \propto p_{inc}^{-0.8\pm0.2}$. (auth)

13843 (COO-1428-333) REVIEW OF EVIDENCE FOR HIGH-MASS K^* STATES. Carmony, D. D. (Purdue Univ., Lafayette, Ind. (USA)). 1973. 7p. Dep. NTIS $3.00.

Evidence for strange mesons above the $K^*(1420)$ is reviewed. The $K_N(1760)$ now appears to be well confirmed with a 9 GeV/c K^+n experiment reporting a mass of 1769 ± 12 MeV and a width of 130 ± 50 MeV and a 7.2 GeV/c K^-p experiment finding a mass of about 1760 MeV and a width of less than 80 MeV. Decays into $K\pi$, $K\rho$, $K^*(890)\pi$ and $K^*(890)\rho$ are seen. The K^+n experiment also reports a state of mass 2115 ± 45 MeV and width 300 ± 100 MeV which is identified with a previously reported antilambda-nucleon state. Decays into $K\pi$, $K^*(890)\pi$, $K\rho$, $K^*(890)\rho$, $K^*(1420)\pi$ and Kf are also found. A 12 GeV/c K^+n experiment finds a single broad enhancement in the high $K\pi$ mass region. (auth)

13844 (COO-1428-344) STUDY OF RARE DECAYS OF MESONS USING THE OMEGA SPECTROMETER. Ghidini, B.; Navach, F.; Palano, M. (Purdue Univ., Lafayette, Ind. (USA). Dept. of Physics). 10 Mar 1973. 14p. Dep. NTIS $3.00.

A proposed experiment is described in which the Omega Spectrometer is used to obtain 2×10^6 good events of final states involving a K^- or $\bar{p}$. The experiment consists of using a negative incident pion beam and triggering on a forward K^- or $\bar{p}$ with the Cherenkov low pressure counter and its associated scintillator hodoscope. Various π^- + p interactions are suggested. The physics interest and technical feasibility are also discussed. (JFP)

13845 (COO-3065-49) STUDY OF π^- INTERACTIONS IN DEUTERIUM AT 7 GeV/c. Cohen, D. H. (Rochester Univ., N.Y. (USA). Dept. of Physics and Astronomy). 1973. Contract AT (11-1)-3065. 198p. (UR-447). Dep. NTIS $12.00.

Thesis.

Utilizing exposures of the BNL and SLAC deuterium-filled bubble chambers to beams of ~7 GeV/c π^- mesons which yielded ~20 events per μb of cross section, the following reactions were studied: (1) $\pi^-d \to pp\pi^-\pi^-$, (2) $\pi^-d \to pp\pi^-\pi^-\pi^0$, (3) $\pi^-d \to pp\pi^-\pi^- + N\pi^0$ ($N \geq 2$), (4) $\pi^-d \to pp\pi^+\pi^-\pi^-\pi^-$, (5) $\pi^-d \to pp\pi^+\pi^-\pi^-\pi^-\pi^0$, and (6) $\pi^-d \to pp\pi^+\pi^-\pi^-\pi^- + N\pi^0$ ($N \geq 2$). An extensive search for isotopic spin 2 multipion resonances in the above reactions was carried out. No evidence was found for the existence of such exotic states, and for each of the above, reactions upper limits of between 2 μb and 6 μb were obtained for their production. Using reaction (1), a study of $\pi^-\pi^-$ scattering was carried out. The isotopic spin 2 $\pi\pi$ s-wave, d-wave and g-wave phase shifts and the elastic cross section were extracted using a modified Chew-Low extrapolation to the pion pole. A value of $-7.7 \pm 1.2°$ for the s-wave phase shift at the K^0 mass was obtained. The measurements are in good agreement with current algebra predictions. Using the sub-sample of reaction (2) that contains a ρ^- meson in the final state, a comparison was made of the $\rho^-\pi^-$ mass spectrum produced in this reaction with the predictions of the Reggeized Deck model. Surprisingly good agreement was found, and the results were interpreted within the framework of dual models of inelastic hadron collisions. Substantial B meson production was observed in reaction (5). The mass and width of the B were measured to be 1217 ± 12 MeV and 115 ± 40 MeV, respectively. It was found that the B is produced largely in quasi-two-body final states, and, on the basis of the observed Δ^0 (1236) B production cross section, a large $\pi A_2 B$ coupling is predicted, which should be observable in other reactions. Also a study of inclusive pion production in π^-d interactions was carried out. It was found that, to a high degree of accuracy, the reaction $\pi^-d \to \pi^-$ + anything can be regarded as the sum of $\pi^-p \to \pi^-$ + anything and $\pi^-n \to \pi^-$ + anything. Then from data belonging to the reaction $\pi^-d \to \pi^+$ + anything the invariant cross section for the reaction $\pi^-p \to \pi^+$ + anything for π^+ mesons that are emitted backward in the laboratory was extracted. (auth)

13846 POSSIBLE ANISOTROPIES IN THE PRODUCTION AND DECAY CORRELATIONS OF THE η (958). Kalbfleisch, G.R.; Borenstein, S.R.; Danburg, J.S.; Strand, R.C.; Vanderburg, V. (Brookhaven National Laboratory, Upton, New York, 11973); Chapman, J.W.; Kiang, R.K.; Lys, J.; Rittenberg, A. Phys. Rev. Lett. 31: No. 5, 333-336 (30 July 1973).

The spin and parity analysis of the η (958) from the distribution of events on the $\pi^+\pi^-\eta$ and the $\pi^+\pi^-\gamma$ Dalitz plots has been shown to favor $J^P=0^-$ over 2^-, but not conclusively. The Brookhaven National Laboratory-University of Michigan data reported here indicate anisotropies in the production and decay correlation angular distributions. Earlier Lawrence Berkeley Laboratory data dilute these effects. The observed anisotropies weaken the evidence for a $J^P=0^-$ assignment for the η (958). (auth)

13847 INCLUSIVE REACTIONS AT CONVENTIONAL ACCELERATORS. Goldschmidt-Clermont, Y. (CERN, Geneva). Acta Phys. Pol.; B4: No. 6, 805-856(1973).

Some characteristic features of inclusive spectra obtained in experiments at conventional accelerators are reviewed. Discussed are particle multiplicities, longitudinal momenta in the reactions $K^+p \to K^0 + X$, $K^+p \to K^{*+} + X$, transverse momenta. (auth)

13848 K^+p ELASTIC SCATTERING BETWEEN 432 AND 939 MeV/c AND PHASE SHIFT ANALYSIS. Adams, C. J. (Birmingham Univ., Eng.); Cox, G. F.; Davies, J. D.; Dowell, J. D.; Dimbylow, T.; Grayer, G. H.; Hattersley, P. M.; Homer, R. J.; Howells, R. J.; McLeod, C.; McMahon, T. J.; van der Raay, H. B.; Rob, L.; Damerell, C. J. S.; Hotchkiss, M. J. Nucl. Phys.; B66: 36-77(1973).

Measurements of K^+p elastic scattering were carried out at 13 momenta between 432 MeV/c and 939 MeV/c using spark chambers. The data establish unambiguously the constructive interference of the Coulomb and nuclear amplitudes at 432 MeV/c.

The elastic cross section is found to be independent of momentum through the range covered. The phase shifts for S, P, D and F waves are obtained in an energy dependent analysis in which higher waves are held at theoretical values. The initial behavior of the P, D and F amplitudes is quite close to that predicted by the calculation of the peripheral partial waves. Only the P3 and D5 amplitudes become strikingly different with increasing momentum. (auth)

13849 REACTION $\pi^-p \to \pi^+\pi^-n$ NEAR THE THRESHOLD. Batusov, Yu. A.; Bunyatov, S. A.; Gulkanyan, G. R.; Kurbatov, V. S.; Sidorov, V. M.; Yarba, V. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 18: No. 4, 829-836(Oct 1973). (In Russian).

486 events of the reaction $\pi^-p \to \pi^+\pi^-n$ are analyzed by means of the maximum-likelihood method in the energy range 200-260 MeV with mean value of the primary π^--meson energy at 237 MeV (the reaction threshold is 174.4 MeV). The analysis was based on the theory of three-particle production near threshold (Gribov, Anselm, Anisovich). A simple form is obtained for the matrix element squared, satisfactory describing the whole complex of the experimental data: $|M|^2 = |\lambda|^2\{1 + C(k_{12}^2 - E/2)\}$ with the threshold amplitude $|\lambda|^2 = 4.5 \pm 0.6$ and the slope parameter in the spectrum on the square of the relative momentum k_{12}^2 of two pions $C = 3.7 \pm 0.6$; E is kinetic energy of the particles in c.m.s. Energy dependence of the cross section is obtained to be $\sigma = \rho^2(E/m_\pi)^2$ with $\rho^2 = 0.38 \pm 0.05$ mb. Contributions from nonanalytic (linear, quadratic and cubic) terms, involving the $\pi\pi$ scattering length α_0, to the differential cross section are calculated. (auth)

13850 COMPARISON OF THE $K^-\pi^+p$ AND $K^+\pi^-p$ FINAL STATES IN K_L^0p REACTIONS FROM 0.8 TO 3.0 GeV/c. Alexander, G. (Tel-Aviv Univ., Israel); Benary, O.; Borowitz, I.; Grunhaus, J.; Lande, K.; Oren, Y.; Stumer, I.; Burkhardt, E.; Filhuth, H.; Putzer, A.; Bar-nir, I.; Ang, P. Nucl. Phys.; B66: 7-28(1973).

The reactions $\bar{K}^0p \to K^-\pi^+p$ and $K^0p \to K^+\pi^-p$ were studied with a K_L^0-beam having a continuous incident momentum from ~0.8 to ~3 GeV/c. Cross sections for these reactions are evaluated and it is found that $\sigma(\bar{K}^0p \to K^-\pi^+p)/\sigma(K^0p \to K^+\pi^-p) > 1$ in the whole momentum range. No obvious structure is observed in the cross-section behavior which could be attributed to s-channel resonances. The production of resonances in both channels are investigated as a function of incident momentum. Strong presence of $\bar{K}^{*0}(890)$, $Y_1^*(1520)$ and $\Delta^{++}(1236)$ is observed in the S = -1 channel. In the S = +1 channel, strong $K^{*0}(890)$ is seen and the presence of $\Delta^0(1236)$ is also detected. Using existing $K^-p \to \bar{K}^{*0}(890)N$ data and the present $\bar{K}^0p \to \bar{K}^{*0}(890)p$ data we are able to compute the I = 0 cross section, σ^0 ($\bar{K}N \to \bar{K}^*(890)N$), which is found to be larger than the corresponding I = 1 cross section. (auth)

13851 ISOSPIN ANALYSIS OF THE REACTIONS $\pi \pm p \to \pi(N\pi)$ AT 8 GeV/c AND COMPARISON WITH THE RESULTS AT 16 GeV/c. Aachen-Berlin-Bonn-CERN Collaboration and Notre Dame-Pennsylvania-Tohoku Collaboration. Nucl. Phys.; B66: 93-105(1973).

An isospin analysis of the reaction $\pi^\pm p \to \pi(N\pi)$ at 8 GeV/c was made and the results are compared with an analogous analysis at 16 GeV/c previously published, to determine the energy dependence of the effects studied. It is found that isospin-zero-exchange processes are dominant in both cases and practically energy independent, isospin-one-exchange processes are less abundant and are decreasing with increasing energy. Interference effects are, at both energies, very small. The broad enhancement between 1.2 and 1.7 GeV in the I = 1/2 ($N\pi$) mass spectrum due to isospin-zero-exchange, previously reported, is now studied in various mass-bins. It is found that (a) all mass intervals have approximately the same weak energy dependence, (b) all mass intervals have exponential $d\sigma/dt'$ distributions and (c) the slope of these $d\sigma/dt'$ distributions decreases sharply (from ~12 to ~3 GeV^{-2}) as the mass increases. The results are consistent with the interpretation of this enhancement as predominantly due to diffraction dissociation of the target proton. (auth)

13852 NEUTRAL FINAL STATES IN K^-p INTERACTIONS IN THE RANGE FROM 690 TO 934 MeV/c. Baxter, D. F. (Oxford Univ.); Buckingham, I. D.; Corbett, I. F.; Dunn, P. A.; Emmerson, J. M.; Gravey, J.; Hart, F.; Hughes, G.; Jones, C. M. S.; Maybury, R.; Middlemas, N.; Norton, P. R.; Quirk, T. W.; Scheid, J. A.; Segar, A. M. Nucl. Phys.; B67: No. 1, 125-156(1973).

The K^-p reactions with final states $\Lambda\pi^0$, $\Sigma^0\pi^0$, $\Lambda\pi^0\pi^0$, $\Lambda\eta$ and $\Sigma^0\eta$ were studied at 14 momenta between 685 and 934 MeV/c using optical spark chambers. The charged decay products of the Λ are detected by low mass spark chambers while γ-rays from π^0 and Σ^0 decays are detected in high mass chambers. Approximately 250,000 photographs were analyzed from which partial and differential cross sections were determined. These results are presented with an energy dependent, single channel partial-wave analysis. (auth)

Particle Interactions and Properties (Theoretical)

General

Refer also to abstract 13805.

13853 (COO-3235-27) CHANNEL T AND K OPERATORS AND THE HEITLER DAMPING EQUATION FOR IDENTICAL PARTICLE SCATTERING. Kouri, D. J.; Levin, F. S. (Brown Univ., Providence, R.I. (USA). Dept. of Physics). 1973. Contract AT(11-1)-3235. 23p. Dep. NTIS $3.25.

Coupled integral equations linking the direct and exchange (rearrangement) K operators are proposed in analogy to similar ones linking the direct and exchange T operators. It is shown that these pairs of coupled equations lead to the damping equation which was used previously on identical particle scattering and which expresses the unitarity condition. Other formulations of integral equations for the K operator are also discussed. (auth)

13854 (JINR-P2-7167) INCLUSIVE PROCESSES AND SCALE INVARIANCE AT SMALL DISTANCES. Efremov, A. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 16p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.00.

Recently a method was proposed which allows one to take into account the scale invariance at small distances for the processes in physical region. This method was applied to the scattering in diffraction region, large angle scattering and deep inelastic ep-scattering with the results given. The main points of the method could be formulated in terms of three simple rules: 1) t-subgraphs, 2) scaling and 3) factorization. This is applied for an analysis of inclusive reactions, and results in a picture very similar to the multiperipheral or Regge type models but with additional fixed branch points $\sqrt{j-\alpha}$. (auth)

13855 (JINR-P2-7431) SCALE-CHIRAL SUM RULES. Dao Vong Dyc. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 17p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

Sum rules for spectral functions ρ_0, ρ_π, ρ_K are considered as well as for sigma-terms under some definite assumptions on the Hamiltonian density behavior in the scale and chiral transformations. (auth)

13856 (RLO-2041-103) SPIN STRUCTURE OF EXCHANGE PROCESSES. Lam, K. C.; Moravcsik, M. J. (Oregon Univ., Eugene (USA)). 1973. 14p. Dep. NTIS $3.00.

It is shown that the spin-structure of a given reaction with a dynamics of one-particle or one-reggeon exchanges can be reduced to a few simple cases, and hence one can easily devise experimental tests for the validity of all such dynamics in terms of specific and simple polarization experiments. (auth)

13857 KLEIN-GORDON EQUATION RELATED TO THE WAVE MECHANICS OF SPINLESS TACHYONS. Rachman, A. (Faculte des Sciences, Poitiers, France). Lett. Nuovo Cim.; 8: No. 15, 893-899(8 Dec 1973).

It is shown that a new recently proposed Lorentz transformation leads in a natural form to the Klein-Gordon equation for spinless tachyons and to its invariance with respect to the Lorentz transformation. It is also shown to lead to the introduction of a possible wave mechanics for tachyons which presents a simple physical meaning when transcendent reference systems rigidly linked to tachyons are defined. (LBS)

13858 RECENT EXPERIMENTAL SEARCH FOR NEGATIVE-ENERGY TACHYONS. Recami, E.; Mignani, R. (Univ., Catania, Italy). Lett. Nuovo Cim.; 8: No. 13, 780-782(24 Nov 1973).

An argument is presented that negative-energy tachyons do not exist. The argument is based on an apparent inconsistency with special relativity, and a misunderstanding of the Dirac-Stueckelburg-Feynman-Sudarshan "reinterpretation principle". (LBS)

13859 RELATIVISTIC MODELS WITH MULTIPLET STRUCTURE. Barut, A. O.; Duru, H. (International Centre for Theoretical Physics, Trieste, Italy). Lett. Nuovo Cim.; 8: No. 13, 768-770(24 Nov 1973).

A relativistic model with multiplet structure was given by Staunton and van Dam (Lett. Nuovo Cimento, 7: 371 (1973)) and an appropriate mass spectrum was derived. It is shown that their formalism is equivalent to the well-known generalized infinite-

component Majorana equation with rising spectrum. An exact mass spectrum is calculated. (LBS)

13860 GENERALIZATIONS OF THE DIRAC EQUATION. Boehm, A. (Univ. of Texas, Austin); Mainland, G. B. Nuovo Cim.; 18A: No. 2, 308-326(21 Nov 1973).

Finite- and infinite-dimensional generalizations of the Dirac equation are developed from a group-theoretical point of view. The kinematic form factors for the simplest infinite-component spin-$^1/_2$ vector and axial vector currents are calculated. Second-class currents, which are proportional to symmetry breaking, automatically appear in these infinite-component currents. (auth)

13861 HELICITY OR REGGE POLES IN INCLUSIVE REACTIONS. Moen, I. O.; Zakrzewski, W. J. (Cambridge Univ., Eng.). Nucl. Phys.; B65: No. 2, 346-372(1973).

The asymptotic behavior of the two-particle inclusive cross section is studied in the helicity-pole approach. It is found that the two-reggeon-particle couplings defined by taking a Regge limit do not necessarily agree with the couplings as defined by taking a helicity-pole limit. The reason for this possible difference is discussed and some implications of this difference for pomeron couplings are discussed. (auth)

13862 CURRENT-CURRENT COMMUTATORS, SLICES OF THE LIGHT CONE, AND THE VALUE OF THE σ TERM. Cocho, G. (Instituto de Fisica, Universidad Nacional Autónoma de México, México 20, D.F.); Garcia, A.; Giambiagi, J.J. Phys. Rev. D 8: No. 6, 1820-1827 (15 Sept 1973).

Once-integrated commutators of current components are studied. The integration is performed on timelike hyperplanes. The support comes from a "slice" of the light cone, in contrast to the case when the integration is on a spacelike hyperplane, where the support is only the vertex of the cone. Sum rules are obtained whose main property is that only a finite set of intermediate states contribute. These sum rules resemble finite-energy sum rules. An application to chiral-symmetry breaking is given. The value $C = -1.05$ is obtained. Finally an estimation of the σ term is made. Its value ranges from 50 MeV to 127 MeV. (auth)

13863 ENERGY SPECTRUM OF THREE PARTICLES WITH RESONANCE INTERACTION. Dyugaev, A. M. (Inst. of Atomic Energy, Moscow). Yadern. Fiz.; 18: No. 4, 787-790(Oct 1973). (In Russian).

It is shown that if the barrier of the two-particle forces has small penetration, then the effective range approximation is sufficient to determine low-energy characteristics of three-body system. (auth)

13864 PIONIZATION IN A ϕ^3 THEORY LADDER MODEL. Rajaraman, R.; Banerjee, A. (Univ. of Delhi). Nucl. Phys.; B67: No. 1, 171-188(1973).

The inclusive reaction $a + b \to c + X$ is calculated in a ϕ^3 theory ladder model in the pionization region. A Mellin transform method is used to obtain, without resorting to leading term approximations, a double Regge form for the $\langle a\bar{b}c|a\bar{b}c\rangle$ amplitude in this region, resulting in limiting pionization. The Mellin transform method has to be applied with discretion here and is not a trivial extension of the same method as applied earlier to the fragmentation region. It is pointed out that these methods can also be applied to multiple-inclusive reactions, once again giving expected Regge-behaved results. (auth)

13865 MARKOVIAN APPROACH TO MASSLESS PARTICLE DECAY AND RECOMBINATION. Vasholz, D. P. (Univ. of Florida, Gainesville). Nucl. Phys.; B67: No. 1, 157-170(1973).

Massless particle decay and recombination is treated from the viewpoint of pure probability theory, using as a guide the empirical success of the exponential decay law for massive systems. The result is a linked set of linear integro-differential equations. Lorentz invariance is shown to be easily accommodated. As derived, the equations contain two arbitrary functions, one governing decays and the other recombinations. These equations are analyzed in certain special cases. Forms for the decay and recombination functions are proposed on the basis of Lorentz invariance and simplicity. Using phase space considerations, an argument is given that verifies these forms of the decay and recombination functions, and in addition specifies their relative strengths. When this input is applied to photon instability it is found that, first, there is no infrared divergence and secondly a photon emitted at time $t = 0$ will have a probability of $^{24}/_{25}$ to be observed in its original state as $t \to \infty$. (auth)

13866 CHARGE CONSERVATION LAW AND TWO-PARTICLE CORRELATIONS IN INCLUSIVE REACTIONS. Akiyama, Y. (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 49: No. 5, 1758-1760(May 1973).

Some inclusive reaction sum rules that have been obtained based on the charge conservation law are rewritten in terms of correlation functions. One of the correlation-function sum rules gives the charge distribution law and the other gives the relation between one- and two-particle correlations. The results which come from the charge conservation law and the experimental results are discussed. (LBS)

13867 IS MASS QUANTIFIED. Amundsen, R. (Univ., Bergen). Fra Fys. Verden; 35: No. 3, 49-51(1973). (In Norwegian).

The question of the quantification of mass occupied physicists since the earliest days of the quantum theory. Motz has presented interesting views on this subject in Il Nuovo Cimento (v. 12B, Dec. 1972, p. 239-255) and certain aspects of parts of this treatise are presented here. (JIW).

Electromagnetic

Refer also to abstracts 13811, 13993, 14399, 14542, and 14544.

13868 (COO-1112-142) PROBLEMS IN ELECTROMAGNETIC MASS-DIFFERENCE CALCULATIONS. Majumdar, D. P. (Michigan Univ., Ann Arbor (USA). Randall Lab. of Physics). 1972. 13p. (UM-HE-72-39). Dep. NTIS $3.00.

A brief discussion is given on the progress made thus far in calculating the electromagnetic mass differences of elementary particles. Some of the methods discussed include Feynman's method, Cottinghams method, the methods involving Bjorken scaling functions, and the formalism of Dashen and Frautschi. (LBS)

13869 (COO-1112-191) ELECTRO-PRIMAKOFF EFFECT. Goswami, D. N.; Horwitz, N.; Majumdar, D. P. (National Energy Board, Ottawa, Ontario (Canada); Syracuse Univ., N.Y. (USA). Dept. of Physics; Michigan Univ., Ann Arbor (USA). Harrison M. Randall Lab. of Physics). 1971. 45p. Dep. NTIS $4.25.

The electro-Primakoff process (e + nucleus) $\to$ (e + nucleus + π^0) where an off-mass-shell photon interacts with the Coulomb field of the nucleus to produce a π^0 meson is discussed. This process can be a direct means for measuring the momentum dependence of the $\pi^0 \to \gamma\gamma$ coupling when the photons are off-mass-shell. The differential electro-Primakoff cross section was plotted for different values of k^2 for the case when the momentum dependence of the $\pi^0\gamma\gamma$ coupling is neglected, i.e., the value for the coupling constant obtained from the $\pi^0 \to \gamma\gamma$ decay was used. Two representative target materials corresponding roughly to hydrogen and lead were considered. The dependence of the cross section on the angles made by the outgoing pion ($\theta_{\gamma\pi}$, and $\phi_{\gamma\pi}$) and on the electromagnetic form factor is also discussed in some detail. The electro-Primakoff peak occurs at an angle $\theta_k = (|k^2| + m_\pi^2)/2E_\pi^2$ with respect to the virtual photon direction and the cross section has a unique $\phi_{\gamma\pi}$ dependence of the form $C_1(C_2 + \mathrm{Sin}^2\phi_{\gamma\pi})$. Finally, the contribution of the background processes are discussed. Important among these are coherent electro-nuclear and bremsstrahlung production of π^0 mesons. (auth)

13870 (COO-1112-193) MODEL FOR THE LEADING LIGHT CONE SINGULARITY OF THE CURRENT COMMUTATOR. Majumdar, D. P. (Michigan Univ., Ann Arbor (USA). Randall Lab. of Physics). 1972. 18p. (UM-HE-40). Dep. NTIS $3.00.

A model for the current commutator near the light cone where the forward matrix element of the leading bilocal operator $v_\mu(x,p)$ satisfies two equations $\partial_\mu v_\mu(x,p) = 0(x^2)$ and $\Box v_\mu(x,p) = 0(x^2)$ is investigated. In this model the electromagnetic self-energy becomes finite and the scale-breaking term for $W_1(\nu,q^2)$ can be predicted in terms of the scaling function for $\nu W_2(\nu,q^2)$. (auth)

13871 (JINR-P2-7235) ELECTROMAGNETIC EFFECTS IN POLARIZATION IN NEUTRON AND Λ^0-HYPERON SCATTERING BY PROTONS. Koleliovich, B. Z.; Lapidus, L. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

Different polarization effects due to interference between strong and electromagnetic interactions in elastic scattering of two spin $^1/_2$ baryons (n-p, Λ^0-p) are under consideration. The contribution of electromagnetic interaction to the scattering amplitude of general structure in the e^2-approximation is given for general case of particles of different masses. In n-p scattering the spin-dependent electromagnetic interaction gives rise to isospin violating singlet-triplet transitions. One obtains expressions for the cross section of unpolarized particles, for polarization of neutrons and protons, for depolarization tensors D_{ik} and D_{ik} and for transfer polarization tensors K_{ik} and K_{ik} which both became respectively different when singlet-triplet transitions appear, the correlation of polarization and for the cross section of polarized beam on a polarized target. The experimental investigation of polarization effects at small t due to interference of strong and electromagnetic amplitudes permits the direct determination of the spin dependence of forward

hadronic amplitude. The investigation of asymmetry in the cross section on a polarized proton target at small t gives directly conclusions about the difference $(\sigma_0^s - \sigma^s)$. The maximum of neutron polarization at $\Theta = \Theta_m$ varies from −64% to −97% when neutron energy varies from 1 to 20 MeV according to existing data on n-p scattering lengths. The polarization of protons is proportional to $|a_s|^2 - |a_t^2|$ and is about +20% at 1 MeV, goes to zero near 8 MeV and later changes sign. The electromagnetic contribution is essential for A parameter also at low energy/ at small Θ/. The measurements of the depolarization tensor and of the transfer polarization tensor or polarized-polarized cross sections at small Θ gives possibilities for direct determination of the scattering length. In the general case of 100 to 400 MeV electromagnetic contribution is essential for $\Theta \leq 6°$. At high energy at $10^{-3} \leq -t \leq 0.4 \cdot 10^{-5}$ $(GeV/c)^2$ neutrons became strongly polarized but $P_{op} = 0$ and asymmetry in cross section on the polarized target vanishes. The same is valid for Λ-p scattering. In this case the decay of Λ^0 particles works as polarimeter. The polarization of protons is proportional to the $\sigma_0^s - \sigma^s$ difference. (auth)

13872 (JINR-P2-7311) QUASIPOTENTIAL APPROACH TO THE ELECTROMAGNETIC INTERACTION OF SPINLESS CHARGED PARTICLES. Krapchev, V. B.; Rizov, V. A.; Todorov, I. T. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 48p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.50.

A recently proposed quasipotential equation is applied to the bound state calculations for two spinless charged particles. The contribution of the fourth order Feynman diagrams to the potential does not alter the a^4 fine-structure and recoil corrections obtained previously from a 4-potential evaluated in 2-nd order in e. The main contribution of the Lamb shift (of order $a^5 \ln a^{-2}$) is also found in a form symmetric with respect to the two masses. If expanded in inverse powers of the bigger mass it agrees with known results. (auth)

13873 ELECTROMAGNETIC FORM FACTORS OF THE NUCLEON IN A QUARK MODEL. Micu, L. (Inst. for Atomic Physics, Bucharest). Nuovo Cim.; 18A: No. 2, 327-338(21 Nov 1973).

The electromagnetic form factors of the nucleon are evaluated in the infinite-momentum frame using a relativistic generalization of the static SU_6-scheme. The complications due to the concrete treatment of the spin are avoided by assuming ad hoc cut-off functions. The scaling property of the Sachs form factors $G_E(q^2)/G_M(q^2) \to ct$ as $q^2 \to \infty$ is obtained. The asymptotic behavior of the form factors strongly reflects the form of the cut-off function. SU_6-like results are also obtained in the static limit with free quarks. (auth)

13874 HADRONIC ORIGIN OF THE PION MASS. Bars, I.; Halpern, M. B.; Lane, K. D. (Univ. of California, Berkeley). Nucl. Phys.; B65: No. 2, 518-539(1973).

Generalized gauge models of hadrons (and leptons) including $\pi, \rho, A_1, \pi', \rho, A_1, \pi', \rho', A_1', \ldots$ are constructed. In these models, the pion may be taken as a psuedo-Goldstone boson. In a lone loop approximation to the simplest of these models, a strikingly accurate pion mass is obtained, as a function of hadronic (large) parameters. In a supporting current algebra derivation, it is seen that the essential ingredients for the smallness are (a) asymptotic chiral symmetry and (b) a low energy cut-off imposed by Weinberg's second spectral function sum rule. The model also agrees with ρ' data, and predicts an A_1' around $3(GeV)^2$. In addition, the pion form factor is essentially monopole, while the baryon form factors are dipole. (auth)

13875 SINGLE-PARTICLE ELECTROPRODUCTION AND PHOTOPRODUCTION AT LARGE TRANSVERSE MOMENTUM. Scott, D. M. (Cambridge Univ., Eng.). Nuovo Cim.; 18A: No. 2, 271-284(21 Nov 1973).

Single-particle electroproduction and photoproduction at large transverse momentum are investigated in a covariant parton model. It is shown that the constituent interchange diagrams are not gauge invariant to leading asymptotic order, and the further diagrams necessary to obtain gauge invariance are discussed. The same diagrams are found to dominate in the asymptotic limit for both electroproduction with large or small photon momentum squared, and for photoproduction. In the model the processes are shown to have a power law fall-off in energy, with a remaining dependence on the relevant ratios of invariants, similar to the behavior in hadronic cross sections. (auth)

13876 QUASI-REAL ELECTRON METHOD IN HIGH ENERGY QUANTUM ELECTRODYNAMICS. Baier, V. N. (Inst. of Nuclear Physics, Novosibirsk, USSR); Fadin, V. S.; Khoze, V. A. Nucl. Phys.; B65: No. 2, 381-396(1973).

An electron pole approximation is presented, which can be used to calculate cross sections in high energy quantum electrodynamics. A general derivation is given and some applications are considered: (i) bremsstrahlung in electron−electron (positron) collisions at large angles; (ii) photoproduction and electroproduction of a pair of particles on electrons at large angles; (iii) photon emission at large angles when the cross section does not decrease with energy (iv) total cross section for muon pair production in electron−positron collisions via one photon. The case of polarized particles is also discussed. (auth)

13877 QUARK-PARTON FRAGMENTATION FUNCTIONS. Cleymans, J.; Rodenberg, R. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Notas Fis., Cent. Brasil. Pesqui. Fis.; 20: No. 11, 213-217(1973).

The quark parton model for inclusive pion production in the parton fragmentation region is compared with experimental data. (auth)

13878 MODEL FOR THE LEADING LIGHT-CONE SINGULARITY OF THE CURRENT COMMUTATOR. Majumdar, D.P. (Randall Laboratory, University of Michigan, Ann Arbor, Michigan 48104). Phys. Rev. D 8: No. 6, 1828-1832 (15 Sept 1973).

We investigate a model for the current commutator near the light cone where the forward matrix element of the leading bilocal operator $v_\mu(x,p)$ satisfies two equations $\partial_\mu v_\mu(x,p) = 0(x^2)$ and $\Box v_\mu(x,p) = 0(x^2)$. In this model the electromagnetic self-energy becomes finite and the scale-breaking term for $W_1(\nu,q^2)$ can be predicted in terms of the scaling function for $\nu W_2(\nu,q^2)$. (auth)

13879 SCALING AND LOCALITY WITH NO POMERON IN ELECTROPRODUCTION. Suri, A. (Division of Natural Sciences, University of California, Santa Cruz, Santa Cruz, California 95060). Phys. Rev. D 8: No. 6, 1896-1897 (15 Sept 1973).

A recent sum rule of Brandt and Ng implies the existence of a Pomeron contribution in electroproduction. This is shown to be based on an unrealistic assumption. Therefore the conclusions drawn from it are physically unfounded. In particular, electroproduction need not have a Pomeron but can still scale in a causal model. (auth)

13880 J = 0 FIXED POLE IN THE VIRTUAL COMPTON AMPLITUDE. Niégawa, A.; Uematsu, T. (Department of Physics, Kyoto University, Kyoto 606, Japan); Muta, T. Phys. Rev. D 8: No. 6, 1897-1903 (15 Sept 1973).

We show that the residue of the J = 0 fixed pole in the virtual Compton amplitude has itself a pole with the positive residue at the value of t where $\alpha(t) = 0$; here $\alpha(t)$ is a Regge trajectory appearing in the t channel and this point is the so-called sense-nonsense point. Hence the residue of the J = 0 fixed pole has a positive sign at t = 0 [where $\alpha(t) > 0$], which is the sign opposite to the Born term. The experimental relevance of our result to the electroproduction off nucleons is discussed. (auth)

13881 ASYMPTOTIC BEHAVIOR OF THE ANOMALOUS VERTEX FUNCTIONS. Kubo, R. (Laboratory of Nuclear Studies, Cornell University, Ithaca, New York 14850). Phys. Rev. D 8: No. 6, 1890-1895 (15 Sept 1973).

Asymptotic behaviors of the axial-vector-current-two-photon vertex and of its divergence equation are studied in the region where virtual-photon squared masses are large compared with the nucleon mass. By assuming a sum rule of asymptotic functions, we derive some anomalous commutation relations. We also study the asymptotic properties of some particular two-photon processes. (auth)

13882 WEAK-BOSON TRIANGLE ANOMALIES. Tsai, W.; DeRaad, L.L. Jr.; Milton, K.A. (Department of Physics, University of California, Los Angeles, California 90024). Phys. Rev. D 8: No. 6, 1887-1890 (15 Sept 1973).

The causal methods of source theory are used to calculate the triangle anomalies of weak bosons ($W^\pm$ and Z) in a unified gauge theory of weak and electromagnetic interactions (not involving heavy leptons). The pseudoelectric form factors for these particles are also presented. (auth)

13883 ROLE OF POSITRONS IN COMPTON SCATTERING. Stabler, R.C. (R. D. 2, Princeton, New Jersey). Phys. Rev. D 8: No. 6, 1867-1873 (15 Sept 1973).

Projection operators are derived which split the electromagnetic interaction into a "pairlike" interaction and a "fieldlike" interaction. The separation is applied to lowest-order electromagnetic phenomena. All first-order electromagnetic scattering of charged particles is shown to arise from pairlike transitions. For Compton scattering, the pairlike interaction is to yield the Klein-Nishina formula. The primitive self-energy of an electron is shown to vanish for the pairlike interaction alone, if related boundary conditions are imposed on the photon propagator. The usual ultraviolet divergence can thus be attributed to the fieldlike interaction. (auth)

13884 VARIOUS ASPECTS OF DIVERGENT ELECTROMAGNETIC MASSES: ANALYTICITY, SCALING, AND LIGHT-

CONE. Morita, K. (Dalhousie Univ., Halifax, N. S.). Can. J. Phys.; 51: No. 8, 795-803(15 Apr 1973).

Various features associated with the divergent electromagnetic self-mass of a particle are elucidated. Bjorken's original analysis is implemented with a simple convergence theorem which serves as a basis on which various models are discussed regarding their implications on the divergence problem as well as on the scaling property. A simple model of the current commutator function is proposed, on the basis of which it is argued that the quark-model light-cone commutator gives a wrong sign to the divergent self-mass due to its lack of the current conservation. It is also shown that it is the next-to-leading singularities on the light-cone of the commutator that bring forth a (logarithmically) divergent mass shift. (auth)

13885 APPLICABILITY OF THE EIKONAL APPROXIMATION TO SINGLE CHARGED PION PHOTOPRODUCTION AT HIGH ENERGIES. Ernst, W. (Univ. of Bielefeld, Ger.). Nucl. Phys.; B66: 106-114(1973).

Generalized ladder diagrams of a field theoretical model for single charged pion photoproduction are investigated at high energies. It is shown that the propagator approximation, a key approximation for the eikonalization, does not preserve the high-energy limit of the sum over the generalized ladder graphs. This result is in contrast to that found recently in the case of pure hadronic elastic 2-2 scattering amplitudes. (auth)

13886 CONSEQUENCES FROM THE MICROCAUSALITY FOR THE ELECTROPRODUCTION PROCESS. Geshkenbein, B. V.; Komech, A. I. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 18: No. 4, 914-925(Oct 1973). (In Russian).

The microcausality conditions equivalent for electroproduction to the vanishing of the matrix element of current commutators are used as equations which determine the function $W_i(\nu,q^2)$ at $q^2 > 0$, from the known values of $W_i(\nu,q^2)$ at $q^2 < 0$. These equations have a solution if and only if the integrals $\Phi_i(\nu^2/q^2,q'^2)$ of the functions $W_i(\nu,q^2)$ are analytical in q'^2 in the q'^2 complex plane with a cut over positive values of q'^2. The unknown values of the functions $W_i(\nu,q^2)$ at $q^2 > 0$ are equal to the jumps of the functions $\Phi_i(\nu^2/q^2,q'^2)$ on the cut at $q'^2 = q^2$. The functions $W_i(\nu,q^2)$ can be constructed up to the polynomial in ν^2; the matrix elements $\langle p|J_\mu(x)J_\nu(0)|p\rangle$ are constructed up to a function described in Callen-Lehmann representation and up to the even derivatives of this function. (auth)

13887 SHADOWING IN PHOTOPRODUCTION AND INELASTIC ELECTRON SCATTERING FROM COMPLEX NUCLEI. Schildknecht, D. (Stanford Univ., CA). Nucl. Phys.; B66: 398-411 (1973).

The question of higher mass vector state contributions to shadowing in photo- and electroproduction is investigated quantitatively in a simple optical model approach. A large amount of shadowing comparable in magnitude to the one found in photoproduction is predicted also for inelastic electron or muon scattering for moderately large $q^2(\lesssim 2\ \mathrm{GeV}^2/c^2)$ as soon as the energy of the virtual photon lies in the 100 GeV range. Comparison with the available inelastic electron scattering data below 17 GeV ($q^2 \leq 1.5\ \mathrm{GeV}^2/c^2$) shows that even the ρ^0, ω and Φ contributions to shadowing are larger than the experimentally observed shadow. Further experimental work establishing more clearly the transition from strong shadowing in photoproduction ($q^2 = 0$) to its vanishing at sufficiently high q^2 would be desirable to clarify the situation. (auth)

13888 ASYMPTOTIC BEHAVIOR OF FORM FACTORS IN PS-PS COUPLING WITH ELECTROMAGNETIC CORRECTIONS. Manoukian, E. B. (Univ. of Alberta, Edmonton). Nucl. Phys.; B66: 535-545(1973).

Renormalization group techniques are employed to obtain approximate expressions for the large momentum transfer of the form factors in ps-ps coupling with electromagnetic corrections without photon self-energy parts. The main result is that, within our framework, the form factors not only have the desirable vanishing property at infinite momentum transfer but are also free of ghosts in the asymptotic region. None of these properties existed in the earlier treatment of the problem with pure ps-ps interaction. (auth)

13889 TRANSITION RADIATION UNDER THE ANGLE OF THE LIGHT TOTAL INTERNAL REFLECTION FROM THE MEDIUM. Kobzev, A. P.; Mikhalyak, S.; Rutkovski, E.; Frank, I. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 18: No. 4, 865-869(Oct 1973). (In Russian).

Properties are analyzed of the transition radiation in case when the total internal reflection of light from the medium is possible. Maximum in the angular distribution of the transition radiation is near the total internal reflection angle. Strong effect of the absorption coefficient on the transition radiation intensity is shown. Expressions are given for intensity of the transition radiation at the vacuum-transparent medium boundary. (auth)

13890 GLOBAL MODEL OF K^+ PHOTOPRODUCTION. Pickering, A. R. (University Coll., London). Nucl. Phys.; B66: 493-504(1973).

The use of resonance-saturated fixed-t dispersion relations is extended to the associated photoproduction process $\gamma p \to K^+\Lambda$. In contrast with previous analyses it is demonstrated that the Born term couplings in this process are compatible with those determined from K^+p data, namely $(g_\Lambda^2 + 0.8g_\Sigma^2)/4\pi = 12.2 \pm 2.5$. It is found that the distinctive structure of the data at backward angles in the low energy region indicates substantial contributions from the elusive $D_{13}(1700)$ resonance. With the introduction of a very simple model for the imaginary parts of the high-energy amplitudes the 5-16 GeV differential cross section data was fitted and a qualitative description of the polarization data at 5 GeV is obtained. (auth)

13891 CONNECTION OF WEAK AND ELECTROMAGNETIC INTERACTIONS IN THE FRAMEWORK OF THE SU(3) × SU(3) GROUP. Hosek, J. (Inst. of Nuclear Physics, Rez, Czech.). Nucl. Phys.; B67: No. 1, 62-68(1973).

In giving a mass to the fifteen gauge fields of the chiral SU(3) × SU(3) group through the plasmon-generating mechanism in such a way that the remaining Yang-Mills field becomes the electromagnetic $A_\mu^{e.m.} = V_\mu^3 + \sqrt{1/3}V_\mu^8$ it is necessary to assume hypercharge and parity violation. This manifests the natural connection of electromagnetic and weak interactions suggested earlier by Salam and Weinberg. (auth)

13892 MULTIPLICITIES IN ELECTROPRODUCTION AND e^+e^- ANNIHILATION. Kingsley, R. L.; Landshoff, P. V.; Nash, C.; Polkinghorne, J. C. (Cambridge Univ., Eng.). Nucl. Phys.; B65: No. 2, 397-412(1973).

It is shown how more sophisticated versions of the parton model can replace the naive expectation of final state hadrons being produced in ep or e^+e^- collisions in two jets of finite multiplicity, well-separated in rapidity, with a picture that permits the rapidity gap to be filled in and allows the multiplicity to rise with energy, even up to the limit imposed by energy conservation. Large multiplicity is shown to imply a rather slow approach to scaling and a significant tail in the transverse momentum distribution. (auth)

13893 DEEP INELASTIC SCATTERING IN A RENORMALIZED PERTURBATIVE MODEL. Mason, A.L. (Department of Applied Mathematics and Theoretical Physics, University of Cambridge, Cambridge, England). J. Math. Phys. (N.Y.) 14: No. 11, 1601-1619 (Nov 1973).

We sum all the leading contributions to the form factor νW_2 in deep inelastic electron-proton scattering in a field theory with a neutral pseudoscalar gluon. This involves calculating ladder graphs with renormalization insertions. We find that we can express νW_2 in a simple way in terms of the asymptotic behavior of the renormalization parts. For ladders with only gluon rungs we obtain a result similar to Chang and Fishbane's for the Mellin transform of νW_2, namely $z(\ln\nu)(\exp\{(g^2/16\pi^2)[Y(\ln\nu)/(\lambda+1)(\lambda+2)]\}-1)$. Y and z are (calculable) functions depending on the renormalization parts. We also calculate the rather more complicated contribution from ladders with fermion rungs. Our results do not lend any support to the notion of anomalous dimensions. (auth)

13894 COMPTON EFFECT IN THE ENVIRONMENT IN THE REGION OF THE CHERENKOV CONE. Avetisyan, T. K.; Oganesyan, S. G. (Erevan State Univ.). Izv. Akad. Nauk Arm. SSR, Ser. Fiz.; R8: No. 1, 12-19(1973). (In Russian).

The radiation of charged particles in the field of a plain electromagnetic wave in the environment with the index of refraction $n > 1$ in the region of Cherenchov cone is discussed. In the region of critical point a nonlinear scattering of light takes place even in weak fields ($\xi << 1$). The conditions of polyphotonic radiation of the particle in the region of the critical point and Cherenckov cone are found: at each frequency a number of harmonics are radiated at different angles. Because of the effect of refraction and capture of the particle by the wave, Compton effect in the environment takes place up to the critical value of the field ($\xi < \xi_{cr}$). When $\xi > \xi_{cr}$, the radiation has a pure bremsstrahlung character. (auth)

13895 THEORETICAL PROBLEMS IN DEEP INELASTIC SCATTERING. Leutwyler, H.; Otterson, P. (Univ., Bern). pp 1-30 of Scale and Conformal Symmetry in Hadron Physics. Gatto, R. (Ed.). New York; John Wiley and Sons, Inc. (1973).

From scale and conformal symmetry in hadron physics meeting; Frascati, Italy (4 May 1972). See CONF-7205101-.

The first part is concerned with a number of questions concerning the analysis of inelastic electron scattering. These pertain to

the cross sections, scaling laws, light-cone singularities, equal-time sum rules, dispersion relations and electromagnetic mass shift. In the second part some speculative ideas concerning inelastic scattering that was treated on a conservative basis in the first part are briefly outlined. It is pointed out that knowledge of the high-energy behavior of virtual longitudinal photons is extremely inadequate, and a model is formulated in which this high-energy behavior deviates from conventional Regge phenomenology. Finally, some recent work on one-particle saturation of the finite-energy sum rules satisfied by the virtual Compton amplitude is discussed. (LBS)

13896 LIGHT-CONE CURRENT ALGEBRA, π^0 DECAY, AND e^+e^- ANNIHILATION. Bardeen, W. A. (Stanford Univ., CA); Fritzsch, H.; Gell-Mann, M. pp 139-151 of Scale and Conformal Symmetry in Hadron Physics. Gatto, R. (Ed.). New York; John Wiley and Sons, Inc. (1973).

From scale and conformal symmetry in hadron physics meeting; Frascati, Italy (4 May 1972). See CONF-7205101-.

The method of Crewther and Wilson for deriving the Adler formula without direct reference to renormalized perturbation theory, from considerations of light-cone algebra, is considered. An attempt is made to sketch a simpler derivation and to clarify the question of statistics. The use of quark statistics yields $\sigma(e^+e^- \to \text{hadrons})/\sigma(e^+e^- \to \mu^+\mu^-) \to 2$. From the light cone behavior of current products, including connected and disconnected parts, the Adler formula for $\pi^0 \to 2\gamma$ in the PCAC limit is derived. (LBS)

13897 CROSSING IN THE PHYSICS OF THE LIGHT CONE. Preparata, G. (Univ., Rome). pp 167-182 of Scale and Conformal Symmetry in Hadron Physics. Gatto, R. (Ed.). New York; John Wiley and Sons, Inc. (1973).

From scale and conformal symmetry in hadron physics meeting; Frascati, Italy (4 May 1972). See CONF-7205101-.

A brief review is given of the direct applications of light-cone techniques; these include total annihilation into hadrons, massive μ-pair production in pp collisions, and deep inelastic electron and neutrino scattering off protons. The crossing problem is formulated for the simple case of deep inelastic electron-positron annihilation into one hadron plus anything, and the results of a general analysis are described. Suggestions are found from the basic ideas of LC physics for laying down a scheme to extract the analyticity properties of LC amplitudes, which are needed to perform the continuation to crossed channels. These ideas are then applied to the process $e^+e^- \to h +$ anything. (LBS)

Weak

Refer also to abstracts 13667, 13812, and 14316.

13898 MEASUREMENT OF WEAK MESON FORM FACTORS IN SPACELIKE REGIONS. Brene, N. (Univ. of Copenhagen). Nucl. Phys.; B65: No. 2, 307-318(1973).

With the construction of high energy, high intensity accelerators (NAL & CERN, SPS) investigation of neutrino scattering on virtual pions, á la Chew-Low, becomes experimentally possible. It is proposed to analyse the process $\nu + N \to \mu^- + K + \Delta$ to extract the usual K_{13} form factor(s) for spacelike momentum transfer. A model calculation suggests that $f_+(T)$ can be determined reasonably well from a triple differential cross section, whereas only rough information on $f_-(T)$ may be obtained from the transverse polarization of the muon. The experiment proposed requires scanning of several millions of bubble chamber pictures. (auth)

13899 SIMPLE RELATIONS AMONG LEPTONIC WEAK INTERACTIONS. Terazawa, H. (The Rockefeller University, New York, New York 10021). Phys. Rev. D 8: No. 6, 1817-1819 (15 Sept 1973).

In the weak intermediate-vector-boson theory, it is shown that at least one of the effective coupling constants for the leptonic weak interactions, (1) $(\bar{\nu}_e\nu_e)$ $(\bar{l}l)$, (2) $(\bar{l}\nu_l)$ $(\bar{l}\nu_l)$, and (3) $(\bar{\nu}_e\nu_e)$ $(\bar{\nu}_l\nu_l)$, is not smaller than $(1/2)(G/\sqrt{2})$ (where G is the Fermi coupling constant) and that all the coupling constants for (1) and (2) cannot vanish simultaneously unless the coupling constant for (3) is infinitely large. (auth)

13900 BRANCHING RATIO $\Gamma(\pi \to e\nu)/\Gamma(\pi \to \mu\nu)$ WITH ACCOUNT OF ELECTROMAGNETIC CORRECTIONS AND CONTRIBUTION FROM STRONG INTERACTIONS. Terent'ev, M. V. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 18: No. 4, 870-875(Oct 1973). (In Russian).

Contribution to the branching ratio $R = \Gamma(\pi \to e\nu)/\Gamma(\pi \to \mu\nu)$ from structure effects due to the strong interactions in the radiation corrections is calculated. It is shown that these effects may be calculated correctly, using the PCAC hypothesis. The main result is presented by an equation. The contribution from the structure effects is found to be small ($\sim 0.5 \cdot 10^{-3}$ in R). It is noted that in the standard V–A theory of weak interactions the ratio R is predicted with accuracy up to $10^{-2}\%$. (auth)

13901 INTRODUCTION OF ADDITIONAL GAUGE FIELDS IN THE WEINBERG MODEL. Dolgov, A. D.; Zakharov, V. I.; Okun, L. B. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 18: No. 4, 876-889(Oct 1973). (In Russian).

Introduction of new gauge fields in the Weinberg model makes it possible to realize locally all lepton symmetries of the Lagrangian. This procedure does not result in any contradiction between the experimentally observed conservation of the leptonic charge of leptons and the fact that a vector meson interacting with a leptonic charge becomes massive after spontaneous symmetry breaking. It is shown that in theories with a minimum number of scalar bosons (at a given number of vector bosons) the $\nu_e e$ axial constant g_A is still $-1/2$ as in the Weinberg model but in our case the variation range of the vector constant is more broad. The value g_A is not fixed in models with an excess of scalar fields. The practical method for diagonalizing the Lagrangian after spontaneous symmetry breaking is considered in detail. (auth)

13902 TEST OF THE $\Delta S = \Delta Q$ RULE IN K_{e3} DECAY. Hart, J. C.; Hutton, J. S.; Field, J.H.; Sharp, P. H.; Blackmore, E. W. A.; Fisk, H. E.; Manning, G.; Parham, A. G.; Reading, D. H.; Salter, D. C.; Tapper, R. J. (Cavendish Lab., Cambridge, Eng.). Nucl. Phys.; B66: 317-349(1973).

An optical spark chamber experiment was performed to test the $\Delta S = \Delta Q$ rule in the decay $K^* \to \pi^0 e^+ \nu$. Neutral kaons of initial strangeness S = +1 were produced via the reaction $\pi^- p \to \Lambda K^*$. The result obtained was Re x = –0.03 ± 0.07, Im x = 0.09 ± 0.07, which is consistent with no violation of the $\Delta S = \Delta Q$ rule. (auth)

13903 HIGHLY INELASTIC NEUTRINO REACTIONS PREDICTED FROM THE πN TOTAL CROSS SECTIONS. Suzuki, M. (Univ. of California, Berkeley). Nucl. Phys.; B66: 368-380 (1973).

The scaling function $F_2(\omega)$ is calculated for the highly inelastic neutrino and antineutrino reactions from the πN total cross sections on the basis of the generalized scaling sum rules. With the optimum values for the parameters determined in a previous analysis the integral $\int_0^1 dx\,(F_2^{\nu p}(x) + F_2^{\bar{\nu} p}(x))$ saturates almost completely the inequality of the parton quark model. The ultra precocious linear rise of the total cross sections for the neutrino and anti-neutrino reactions is a natural consequence of the generalized scaling sum rules. (auth)

13904 NEUTRINO INDUCED PRODUCTION AND PARTON CHAINS: SCALING FORM FACTORS. Bartelski, J.; Krolikowski, W. (Univ., Warsaw). Bull. Acad. Pol. Sci., Ser. Sci., Math., Astron. Phys.; 21: No. 7, 661-672(1973).

Predictions of the parton-chain model of the nucleon obtained previously for neutrino-production scaling form factors are presented in the form of an atlas of diagrams. A comparison with predictions of the model for electroproduction scaling form factors is made. The global predictions of the model are compared with CERN propane and Gargamelle data. (auth)

13905 EXPERIMENTAL ESTIMATE OF INTERACTION OF ANTINEUTRINO WITH MATTER AT LOW ENERGY TRANSFERS. Bazhutov, Yu. N.; Martem'Yanov, V. P.; Mikaelyan, L. A. (Inst. of Atomic Energy, Moscow). JETP Lett. (USSR) (Engl. Transl.); 18: No. 5, 183-184(5 Sep 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 5, 312-314(5 Sep 1973).

The upper bound of the specific energy loss of reactor antineutrino ($\bar{\nu}$) in matter, $j \leq (0.4 \pm 0.9) \times 10^{-15}$ MeV-cm^2/g, and the upper bound of the ionization cross section, $\sigma \leq (0.5 \pm 0.5) \times 10^{-36}$ cm^2/electron were obtained experimentally. The results exclude the possibility of explaining the problem of observation of solar neutrinos by using the anomalous energy loss with an energy transfer $\epsilon \gtrsim 10$ eV in each interaction act, assuming that the ν and $\bar{\nu}$ interactions with electrons are equivalent. (auth)

13906 THEORETICAL ESTIMATE FOR THE SLOPE OF THE SCALAR K_{13} FORM FACTOR AT THE ORIGIN. Genz, Z. (Univ., Munich); Katz, J. Lett. Nuovo Cim.; 8: No. 12, 753-757(17 Nov 1973).

A theoretical estimate is made of the slope λ_0 of the scalar K_{13} form factor F(t) at t = 0 in terms of the pion tensor mass radius r_π. A prediction of $\lambda_0 = -0.024 \pm 0.02$ is obtained in good agreement with previous experimental results. (LBS)

Strong (General)

Refer also to abstract 14576.

13907 (CERN-73-12, pp 1-138). MULTIBODY PHENOMENA IN STRONG INTERACTIONS. Jacob, M. (CERN, Geneva). 24 Sep 1973.

An attempt is made to assess most recent data on multiple production in strong interactions at a phenomenological level.

Topics discussed are: elastic scattering and total cross sections; scaling and the approach to scaling; diffraction dissociation; two-body correlations; and large transverse momentum phenomena. (LBS)

13908 (CERN-73-12, pp 139-169) INTRODUCTORY MATERIAL (REGGEISM, DUALITY, ETC.). Kajantie, K. (Univ. of Helsinki). 24 Sep 1973.

It is shown how Regge analysis and the duality framework for ab → cd can be extended to the inclusive reaction ab → cx. (LBS)

13909 (CERN-73-12, pp 171-249) MULTIBODY PHENOMENA IN STRONG INTERACTIONS: DESCRIPTION OF HADRONIC MULTIBODY FINAL STATES. Koba, Z. (Niels Bohr Inst., Copenhagen). 24 Sep 1973.

The kinematic framework of describing the many-body final states of inelastic collisions of hadrons are considered. Five sets of quantities are treated: exclusive cross sections, inclusive cross sections, inclusive correlations, density moments, and density correlations. The discussion consists of three parts: integrated quantities; differential quantities; and applications to scaling of multiplicity distribution and to associated multiplicity and semi-inclusive cross sections. (LBS)

13910 (CERN-73-12, pp 251-283) DEEP INELASTIC LEPTON–HADRON INTERACTIONS AT HIGH ENERGIES. Matveev, V. A. (Joint Inst. for Nuclear Research, Dubna, USSR). 24 Sep 1973.

An introductory review is given of the main ideas and elements of theoretical tools in studying the deep inelastic processes of high-energy lepton–hadron interactions. Topics covered include the kinematics of deep inelastic processes; muon pair production in hadron-hadron interactions; and dimensional analysis and the automodelity principle in physics of deep inelastic interactions. (LBS)

13911 (CERN-73-12, pp 285-361) AUTOMODEL BEHAVIOR IN TWO- AND MANY-BODY HADRON REACTIONS. Muradyan, R. M. (Joint Inst. for Nuclear Research, Dubna, USSR). 24 Sep 1973.

The following questions are discussed on the basis of the automodelity hypotheses and dimensional analysis: differential cross sections of elastic and quasi-elastic reactions in deep elastic region, asymptotic behavior of electromagnetic form factors of hadrons, and asymptotic behavior of inclusive hadron reactions at small and large transverse momenta. (LBS)

13912 (COO-1112-165) IMPACT PARAMETER DESCRIPTION OF MULTIPARTICLE AND ELASTIC SCATTERING, WITH AN APPLICATION TO THE MULTIPERIPHERAL MODEL. Henyey, F. S. (Michigan Univ., Ann Arbor (USA). Randall Lab. of Physics). 1973. 28p. (CONF-730334-8; UM-HE-73-11). Dep. NTIS $3.50.

From 8th Recontre de Moriond conference; Meribel-les-Allues, France (4 Mar 1973).

Impact parameter variables are defined for a multiparticle production process. The equation of unitarity for elastic scattering is written at high energy in terms of these variables. The overall impact parameter can be expressed in terms of the impact parameters of all the produced particles. The unitarity equation becomes an "optical theorem" at each impact parameter—diffractive scattering is given by beam depletion. These features allow this technique to give a much clearer interpretation of unitarity in any model than has heretofore been possible. As an application of this technique, the multiperipheral model is examined. Short range order is shown to be equivalent to a random walk in impact parameter. Short range order, with an energy independent correlation length, is shown to be inconsistent with the combination of elastic and multiparticle data. Alternative models are suggested by use of this technique. (auth)

13913 (COO-1112-187) PHENOMENOLOGY OF DIFFRACTIVE REACTIONS. Kane, G. L. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). 1972. 65p. (RPP/T-20). Dep. NTIS $5.25.

Diffractive reactions are discussed giving close attention to the detailed features of relevant experimental data. It is argued that the traditional views are not adequate to describe the actual data at energies where it is currently available. Three problems are considered: crossovers, slope-mass correlation, and the size of the diffractive cross sections. Various solutions discussed which include: large Reggeon exchange, Pomeron contribution, s-channel helicity amplitudes, forward turnovers, diffraction production amplitudes, and slope-mass correlation. Other topics discussed are helicity conservation, duality, hyperon beams, and very high energies. (LBS)

13914 (COO-1112-194) TOWARD A GENERAL DESCRIPTION OF TWO-BODY HADRON REACTIONS. Hartley, B. J.; Kane, G. L. (Michigan Univ., Ann Arbor (USA). Dept. of Physics). Jan 1973. 103p. Dep. NTIS $7.25.

A model for describing two-body high energy hadron reactions at energies above the resonance region is presented. Although no real theory yet exists, one can give a procedure for obtaining a (possibly correct) description of the amplitudes for any two-body reaction (whatever the spins involved, including real and imaginary parts of amplitudes, any helicity flip π exchange as well as vector and tensor exchanges, etc.). The most important new physical effect involved is using the appropriate t-dependent phase for the vacuum exchange amplitude (the "Pomeron"), both in elastic scattering and in describing absorption effects. The Pomeron is not a Regge pole. The model is very simple to formulate and has a reasonable physical interpretation in terms of important unitarity effects and absorption. It allows one to understand the partial successes and the inadequacies of previous approaches such as the dual absorptive model the strong absorption model, the view that some amplitudes have Regge pole behavior while others do not, etc. All the $0^-\frac{1}{2}^+ \to 0^-\frac{1}{2}^+$ reactions, $np \to pn$, and $\bar{p}p \to \bar{n}n$, cross sections, polarizations, and amplitudes; these include all the important kinds of helicity amplitudes for any two-body reactions. Apart from a few places the results are very good; it is argued that the few places where there may be some difficulty are due to effects we have left out rather than to the structure of the model. Although the input Reggeon exchanges are not all exchange degenerate, the phases of the output amplitudes after absorption show a remarkable and unexpected resemblance to what one would expect from exchange degenerate poles, apart from the necessity of having a zero structure related to important absorption corrections. A number of related results, some of which are considered puzzles are discussed (total cross section differences for πN and KN, the increase in $\sigma_T(K^+p)$, crossovers, shrinkage, real parts of elastic amplitudes, polarization single and double zeros, line reversed reactions, pp scattering at the ISR, etc.) and some predictions are given. (auth)

13915 CLUSTERING EFFECTS IN HIGH ENERGY MULTIPARTICLE PRODUCTION. Hayot, F.; Morel, A. (CEN, Saclay, France). Acta Phys. Pol.; B4: No. 6, 941-951(1973).

The effects of fireball production on correlations in inclusive spectra are reviewed. Both integrated and differential correlations are discussed. (auth)

13916 CORRELATIONS AND MULTIPLICITY DISTRIBUTIONS IN MULTIPARTICLE PRODUCTION. Le Bellac, M. (Univ., Nice). Acta Phys. Pol.; B4: No. 6, 901-939(1973).

A general discussion of Short Range Order hypothesis and its comparison with experimental data on correlations in inclusive spectra is given. (auth)

13917 DECISIVE TESTS OF DUAL GEOMETRICAL MODELS FOR TWO-BODY HADRONIC PROCESSES. Kohsaka, Y.; Takagi, F. (Tohoku Univ., Sendai). Lett. Nuovo Cim.; 8: No. 15, 881-888(8 Dec 1973).

A comparison is made among the various dual geometrical models that have been proposed for the phenomenological description of two-body and quasi-two-body hadronic processes, and decisive ways to test them experimentally are presented. (LBS)

13918 MULTIPERIPHERAL MODELS. Chernavskii, D. S. (Lebedev Inst. of Physics, Moscow). Acta Phys. Pol.; B4: No. 6, 885-900(1973).

A multiperipheral model, based on a quantum field theory approach (equations of the Bethe–Salpeter type), is discussed. Statistical processes are taken into account as an irreducible part of the Bethe–Salpeter equation. The fire-ball formation is obtained as a result of statistical processes of such a type. (auth)

13919 TOWARDS A RENORMALIZABLE UNIFIED GAUGE THEORY OF STRONG, ELECTROMAGNETIC, AND WEAK INTERACTIONS. Nanopoulos, D. V. (Univ. of Sussex, Brighton, Eng.). Lett. Nuovo Cim.; 8: No. 15, 873-877(8 Dec 1973).

It is shown that there exists a large and well-defined class of non-Abelian strong interactions, which have the property of being asymptotically free, giving the parity and strangeness violation of correct order α/M^2. It is also shown that terms in the effective Lagrangian that break natural zero-order symmetries of strong interactions are given exactly to order α by a few one-loop Feynman diagrams. (LBS)

13920 EVALUATION OF A ZERO INTERCEPT DUAL MODEL BY RATIONAL FUNCTIONS. Clavelli, L. (Argonne National Lab., Il.); Fenster, S.; Uretsky, J. L. Nucl. Phys.; B65: No. 2, 373-380(1973).

A ghost-free zero-intercept dual model constructed by Gervais

and Neveu is found to be Regge-behaved but not st symmetric in the four-point function. If the s-channel is taken to be tachyon-free, a tachyon appears in the t-channel. (auth)

13921 FEATURES OF MULTIPLICITY DISTRIBUTIONS IN A BOOTSTRAP MODEL OF INCLUSIVE SPECTRA. Jengo, R.; Krzywicki, A.; Petersson, B. (Laboratoire de Physique Theorique et Particules Elementaires, Orsay, France). Nucl. Phys.; B65: No. 2, 319-332(1973).

Using a bootstrap model of inclusive spectra an integral equation satisfied by the generating function for multiplicity distributions is derived. The (semi-asymptotic) solution of this equation has the form $\phi(\lambda,s) = \phi(\lambda,s_0)(s/s_0)^{b(\lambda)}$ where s is the usual energy variable and $b(\lambda)$ satisfies an eigenvalue equation and is completely determined by the leading particle distribution. Closed formulae for the binomial moments and for correlation coefficients are also given, and in addition some general features of the bootstrap model are discussed. As a phenomenological application the rate of variation with energy of multiplicity moments is discussed. The results are expected to be representative for multiperipheral-like models. (auth)

13922 GAUGE CONDITIONS IN THE DUAL FERMION MODEL. Corrigan, E. F.; Goddard, P. (Univ. of Durham, Eng.). Nuovo Cim.; 18A: No. 2, 339-359(21 Nov 1973).

Techniques are developed for handling the vertex for fermion emission in Ramond's model. These are used to show the vertex for ground-state emission successfully converts all the Virasoro fermion gauge operators into meson ones and vice versa. This is more than is guaranteed by duality. Further it is proved that the vertex converts fermion F_N gauges into sums of G_m ones. Unfortunately the more important converse result fails to hold. (auth)

13923 INCLUSIVE REACTIONS IN THE CENTRAL REGION AND THE ALGEBRA OF VERTEX STRENGTHS. Koca, M. (Middle East Technical Univ., Ankara, Turkey). Lett. Nuovo Cim.; 8: No. 12, 735-739(17 Nov 1973).

The predictions of the algebra of vertex strengths for inclusive interactions in the central region are investigated. Relations among hadronic total cross sections are obtained and are analyzed on the basis of the familiar Regge-pole singularities. (LBS)

13924 NEW LIGHT ON THE NEVEU–SCHWARZ MODEL. Fairlie, D. B.; Martin, D. (Univ. of Durham, Eng.). Nuovo Cim.; 18A: No. 2, 373-383(21 Nov 1973).

The Neveu–Schwarz model is revealed as possessing the same Koba–Nielsen structure as the original dual-resonance model in a formalism where the Koba–Nielsen variables are extended by the incorporation of anticommuting variables. (auth)

13925 SYMMETRY CONSTRAINTS OF INCLUSIVE REACTIONS IN THE PIONIZATION REGION. Leroy, D.; Van Parijs, J. (Univ., Louvain, Belg.). Ann. Soc. Sci. Brux. Ser. I; 87: No. 3, 357-365(25 Oct 1973).

The constraints on inclusive cross sections in the pionization region imposed by isospin conservation and by Mueller's theorem are considered, assuming that Regge poles are exchanged. This will enable different reactions to be compared with respect to the way they reach the scaling limit. (auth)

13926 VACUUM STATE IN DUAL MODELS. Volkov, D. V.; Zheltukhin, A. A.; Pashnev, A. I. (Physical-Technical Inst., Kharkov). Yadern. Fiz.; 18: No. 4, 902-913(Oct 1973). (In Russian).

The consistence of the assumption on the particle transition to the vacuum with the dual conception is discussed. It is shown that the effect of the particle transition to vacuum results in the renormalization of the coupling constant, masses of external particles and of the intersection parameter α_0 in the model under consideration. (auth)

13927 EFFECT OF POLARIZATION ON HADRON INCLUSIVE SPECTRA. Kobrinskii, M. N.; Likhoded, A. K. (Inst. of High Energy Physics, Serpukhov, USSR). Yadern. Fiz.; 18: No. 4, 890-893(Oct 1973). (In Russian).

The effect of polarization of initial particles on inclusive spectra is considered. It is shown that these spectra are independent of polarization in the framework of the quark theory. Possible variation of the proton spectrum due to the $\Delta(1236)$-resonance alignment is estimated. (auth)

13928 GAUGE THEORIES INCLUDING THE BUDDHA (AND SUCH VECTOR MESONS WITH CP = −1). Halpern, M. B. (Univ. of California, Berkeley). Nucl. Phys.; B66: 78-92(1973).

Natural generalizations of the gauge theory of hadrons (and leptons) are constructed, now to include the B(1235) and possibly other mesons with CP = −1. This leads to a concept of pseudospin multiplets including ρ, ρ', A_1, and B-type particles; this provides then a renormalizable approach to all known particle types with $J \leq 1$. A number of interesting mass relations and intriguing structure is found. (auth)

13929 BARYON SPECTROSCOPY AND THE QUARK SHELL MODEL. I. The Framework, Basic Formulae, and Matrix-Elements. Horgan, R.; Dalitz, R. H. (Oxford Univ.). Nucl. Phys.; B66: 135-172(1973).

Baryonic states are discussed in terms of a three-quark shell-model with $SU(6)_\sigma \otimes O(3)$ symmetry and harmonic oscillator wavefunctions. For all states with $N = 0$, 1 or 2 quanta of excitation, which comprise the following supermultiplets: $(56,0^+)_0$, $(70,1^-)_1$, $(56,2^+)_2$, $(70,2^+)_2$, $(56,0^+)_2$, $(70,0^+)_2$ and $(20,1^+)_1$, wave functions which are symmetric for permutations on the three quark labels are constructed in the $SU(3) \otimes SU(2)_\sigma \otimes O(3)$ basis appropriate to this symmetry, and the structure of these wavefunctions in terms of two-quark substates is made explicit. A general mass operator is considered which is a linear combination of two-body operators, each of which conserves isospin and hypercharge and transforms under $SU(6)_\sigma \otimes O(3)$ according to an irreducible tensor representation. These operators are constructed by use of the Wigner-Eckart theorem for $SU(6)_\sigma$ and are written in a way which makes transparent their effect on the wavefunctions constructed. The calculation of their matrix-elements then becomes a straightforward and systematic operation, and these are tabulated for all operators which are spin-scalar (central) or spin-vector (spin-orbit) in character, and have either singlet or octet character with respect to SU(3). All 27-tuplet SU(3) operators are also given (but not their matrix-elements). Relationships are also derived between reduced matrix-elements for different supermultiplets, some depending only on the shell-model character of the wavefunctions and others depending specifically on their harmonic character, which act to constrain greatly a simultaneous fitting of all the supermultiplets $N \leq 2$. (auth)

13930 SEMICLASSICAL ELEMENTARY PARTICLE MODELS. Delaney, W. (Centro Studie e Applicazioni in Technologie Avanzate, Bari, Italy). Int. J. Theor. Phys.; 8: No. 4, 307-317(1973).

Some simple models of elementary particles are discussed; they may be described as semiclassical, quark, shell models. Particles are assumed to be composed of spherical concentric charged shells. Three basic types of shell are allowed, quantum numbers are associated with each type such as to establish a quantum number correspondence between the shell types and the (p,n,λ) quarks. Particles are identified through the quantum numbers of their constituent shells (quarks). The basic assumptions underlying the models considered are relationships between the electromagnetic energy associated with elementary particles (quark systems) and particle masses. The electromagnetic energy is represented classically; the models are semiclassical in that the shell radii are related to particle Compton wavelengths. Particle mass and magnetic moment formulas are derived, possible values for quark masses are suggested, and possible connections of the models considered with particle symmetry schemes are discussed. (auth)

13931 LIGHT-CONE PHYSICS AND DUALITY. Del Giudice, E.; (Univ., Naples); Di Vecchia, P.; Fubini, S.; Musto, R. pp 153-166 of Scale and Conformal Symmetry in Hadron Physics. Gatto, R. (Ed.). New York; John Wiley and Sons, Inc. (1973).

From scale and conformal symmetry in hadron physics meeting; Frascati, Italy (4 May 1972). See CONF-7205101-.

The analogies between the light-cone approach and the dual resonance model for hadron physics are investigated, starting from the light-cone point of view and recovering some interesting properties of the dual resonance model. The properties of the products of currents for lightlike distances, especially of current commutators, and their consequences for the asymptotic behavior (Bjorken limit) of scattering processes are extensively discussed. A discussion is given of the deep inelastic structure functions obtained in the model. (LBS)

Strong (Baryon No. = 0)

13932 (COO-1112-188) ANTIPROTON–NEUTRON BOUND STATE. Ju, I.; Tomozawa, Y. (Michigan Univ., Ann Arbor (USA). Harrison M. Randall Lab. of Physics). Aug 1972. 10p. (UM-HE-72-30). Dep. NTIS $3.00.

The possibility of an antiproton-neutron bound state for explaining a narrow peak which was found recently in the experiment $\bar{p} + n \to 4\pi$ and 6π is discussed. It is pointed out that the state is likely to be a $^1P_1$ state or a higher angular momentum state. (auth)

13933 (COO-1428-334) CURRENT STATUS OF MESON SPECTROSCOPY. Miller, D. H. (European Organization for

Nuclear Research, Geneva (Switzerland); Purdue Univ., Lafayette, Ind. (USA)). 25 Jul 1973. 85p. Dep. NTIS $6.25.

The review of the current status of meson spectroscopy is basically composed of results published between January 1972 and June 1973. Some historical perspective is included, together with indications of directions this subject will take in the future. The discussion is outlined as follows: review of the current situation; experimental results in the region M < 1.7 GeV; experimental results on high mass and high spin mesons; some new results on various topics; and future directions. A list of all nonstrange mesons confirmed or claimed is included. (LBS)

13934 ANGULAR-MOMENTUM COMPONENTS OF THE ρ MESON. Gregor, M. H. (Univ of California, Livermore). Nuovo Cim.; 18A: No. 2, 169-187(21 Nov 1973).

A model is investigated in which the ρ-meson is described as a "quark–quark" pair in an L = 1 orbital-angular-momentum state. This model is in line with suggestions obtained from applications of $SL_{3,R}$ algebra. By attributing the large spread in energies of the ρ to a spread in orbital rotational energies, it is concluded that the ρ has a corresponding spread in angular-momentum values: the ρ is in a pure L = 1 state only at the peak of the resonance. A quantitative comparison of calculations with a recent Berkeley $\pi\pi$ phase-shift analysis appears to substantiate this viewpoint. This model, which reproduces the properties of the ρ-meson, is readily extended to reproduce the properties of the ω-meson. (auth)

13935 DUAL ANALOG MODEL FOR πN AND NN ELASTIC SCATTERING. Traenkle, E. (Freie Univ., Berlin). Nuovo Cim.; 18A: No. 2, 360-372(21 Nov 1973).

The model is an extension of the analog model by Fairlie and Nielsen. In the case of πN scattering the conducting plate has the shape of a polygon of two circular arcs, whereas in NN scattering the shape is a polygon of four circular arcs. The boundary value problem is solved by constructing the conformal mapping of the arc polygons onto the unit circle. The shifting of the Δ trajectory and the exotic trajectory with respect to the f trajectory is predicted to be $-1/3$ and $-2/3$ respectively. The residues of the f Regge pole in $\pi\pi$, πN and NN scattering factorize. Some phenomenological consequences are discussed. (auth)

13936 RESTRICTIONS ON THE INTERACTION BETWEEN MASSIVE VECTOR MESONS. Velo, G. (Univ., Bologna). Nucl. Phys.; B65: No. 2, 427-444(1973).

A critical investigation of the most general Lagrangian describing any number of massive vector mesons coupled through parity conserving interactions with dimensionless coupling constants is made. The theory is required to satisfy the following three conditions which are necessary on physical grounds: the presence of the interaction must not change the number of degrees of freedom of the system, the equations must describe propagation, and the propagation must take place at a speed less than that of light. One finds that some of the coupling constants are zero and others are related. The Lagrangian density takes a very simple form which generalizes, apart from the mass term, the Yang-Mills Lagrangians. (auth)

13937 SUM RULE INEQUALITIES AND SUBTRACTIONS IN $\pi\pi$ DISPERSION RELATIONS. Common, A. K. (Univ. of Kent, Canterbury, Eng.). Nucl. Phys.; B65: No. 2, 290-300(1973).

Sum rule inequalities on the $\pi\pi$ scattering amplitudes are derived from analyticity, S ↔ u crossing properties and positivity of these amplitudes. They connect the real and imaginary parts of the amplitude in the energy region where they may be calculated from phase-shift analysis, and do not require knowledge of these quantities at low energies or in the high energy region. The sum rules are used to confirm earlier results that two subtractions are needed in $\pi\pi$ dispersion relations and this conclusion is now much more definite since in contrast to the earlier work, no knowledge of the magnitude of the absorptive part of the amplitude in the low energy region is needed. (auth)

13938 NEW RIGOROUS BOUNDS ON COUPLING CONSTANTS IN FIELD THEORY. Healy, J.B. (Rockefeller University, New York, New York 10021). Phys. Rev. D 8: No. 6, 1904-1914 (15 Sept 1973).

We improve the rigorous upper bound derived by Łukaszuk and Martin for the π^0–π^0 scattering amplitude at the symmetric point. Our principal new tool is the "parametric dispersion relation" of Auberson and Khuri. Also, for a ϕ^4 field theory with a scalar bound state, we establish an upper bound on the physical coupling constant to the bound state as a function of its mass. Numerical examples of this bound are given for several bound-state masses. (auth)

13939 TIGHT CONNECTION BETWEEN THE HIGH ENERGY t-BEHAVIOR AND THE LOW ENERGY AMPLITUDES IN $\pi\pi$ SCATTERING. Souza, M. (CEN de Saclay, Gif-sur-Yvette, France). Nucl. Phys.; B66: 305-316(1973).

By dispersion-relation techniques, it is shown that there is a strong connection between the low-energy behavior of $\pi\pi$ amplitudes and the existence or not of cross-over-like zeros in the real and imaginary parts of the $I_t = 1$ $\pi\pi$ high-energy amplitude. Various low-energy inputs are used, and the corresponding high-energy behaviors are discussed in the framework of Regge-like models with cut corrections. (auth)

13940 μ DECAY AND NEUTRINO–NEUTRINO INTERACTIONS IN A NONLOCAL THEORY OF WEAK INTERACTIONS. Malyshkin, V. G.; Sibold, K. (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Phys.; B67: No. 1, 260-268(1973).

The contributions of the ordinary current–current weak interaction and a pure $\nu\nu$ interaction to the spectrum of μ decay to second order are analyzed in the framework of a non-local theory of weak interactions. Comparison of the obtained results with experimental data allows an upper bound on the coupling constant of the $\nu\nu$ interaction to be established. (auth)

13941 DYNAMICAL MODEL FOR THE ABC EFFECT. Anjos, J. C.; Levy, D.; Santoro, A. (CEN de Saclay, Gif-sur-Yvette, France). Nucl. Phys.; B67: No. 1, 37-61(1973).

A model for ABC production is presented, which is experimentally observed in the missing mass spectrum of the reaction dp → ^{3}He + $(MM)^0$. The reaction is assumed to be split in two successive steps, namely: (i) $N_1p \to d_1\pi_1$ followed by (ii) $N_2d_1 \to {}^3He\pi_2$, N_1 and N_2 being the two nucleons of the incident deuteron and d_1 an intermediate deuteron. The total amplitude is factorized into the product of the two amplitudes of reactions (i) and (ii). It is known that at low energy these two reactions are dominated by Δ production. This implies that the total cross sections are given by Breit-Wigner type formulae and that the angular distributions are peaked in the backward and forward directions. The two main results are: (i) at given incident energy, the ABC effect results from the angular distribution of the two intermediate reactions; (ii) the energy dependence of the ABC is deduced from those of the intermediate processes. The resulting fits are generally excellent when the Fermi motion in the initial deuteron is taken into account. (auth)

13942 BOUNDS ON THE DERIVATIVES OF THE PARTIAL WAVES FOR THE PION–PION SCATTERING. Dita, P. (Inst. of Physics, Bucharest). Rev. Roum. Phys.; 18: No. 8, 1051-1054(1973).

Bounds on the derivatives of the upper waves ($l \geq 4$) are obtained for the reaction $\pi^0 + \pi^0 \to \pi^0 + \pi^0$. Namely, the problem is solved: given the D partial-wave $f_l(s)$ at an arbitrary point s, $0 < s < 4$, find the allowed range of values of the derivatives $f_l^i(s)$, $l \geq 4$, at the same point. (JFP)

13943 MODEL OF SCALAR MESONS. Kyriakopoulos, E. (Democratus Nuclear Research Center, Athens). Int. J. Theor. Phys.; 8: No. 4, 283-297(1973).

A model containing a nonet of scalar mesons S, a nonet of pseudoscalar mesons P, and a nonet of baryons is constructed where the mesons enter in the form of the matrix $M = e^{i(S+iP)}$. Several Lagrangians are introduced such that the mesons get their physical masses, and the decay widths of the scalar mesons are calculated. The model satisfies generalized PCAC. It is found that the coupling constants of the mesons ϵ (700) and ϵ'(1060) to pions and nucleons satisfy the relations: $G_{\epsilon NN}/G_{\epsilon\pi\pi} = 1.4$, $G_{\epsilon' NN}/G_{\epsilon'\pi\pi} = 0.89$, $G_{\pi\pi}G_{NN}/4\pi = 4.9$, and $G_{\epsilon'\pi\pi}G_{\epsilon' NN}/4\pi = 0.34$. (auth)

13944 APPLICATION OF HARD-PION FOUR-POINT LAGRANGIAN FORMULATION TO THREE CHARGED PION ANNIHILATION OF THE ANTI-PROTON NEUTRON SYSTEM AT REST. Panday, R. C. Boston; Northeastern Univ. (1972). 101p. University Microfilms Order No. 73-28,837.

Thesis (Ph. D.).

The possibility of explaining the antiproton neutron annihilation from the singlet $^1S_0$, I = 1 state at rest into three charged pions on basis of SU(2) × SU(2) current algebra, the conditions of PCAC, CVC and single meson saturation of intermediate states in T-products. The antiproton neutron system is equated to a negatively charged off-shell pion π^-. Its subsequent decay is simply the crossed $\pi^+\pi^-$ scattering process with one of the pions off-mass-shell. The Adler consistency condition for the soft pion limit is clearly obtained with this definition. The off shell pion is then evaluated at $q^2 = (m_{\bar{p}} + m_N)^2$ to calculate the annihilation at rest. The $\sigma\pi\pi$ coupling constant parameters λ_1 and λ_2, which are unconstrained by the conditions of current algebra are determined to have equal and opposite values $\pm 1/\sqrt{2}$ from fits to the Dalitz plot. This corresponds to the σ-width of 800 MeV and favors a "down–down" solution for s-wave I = 0 phase shifts. A destructive interference between vector and scalar fields suppress the ρ-pole effects in the lower energy region, in accordance with observed distribution, and events in the low s,

low t corner of phase-space region are completely wiped out. The hole in the center of the Dalitz plot is found to be a natural consequence of the field equations of motion for intermediate vector and scalar fields. One can explain the distribution of events in the lower and intermediate energy regions with a Lagrangian considering only minimal four point terms and calculating only in the tree and sea-gull approximation. The expressions for S and P wave phase-shifts and I = 0, 1, 2 isospin states in off-shell scattering are presented. A general four-point nonminimal Lagrangian is also considered with two more couplings unconstrained by current algebra (but satisfying the PCAC condition). It gives additional sea-gull terms in the amplitude but does not have pole like terms. While such a structure can simulate the f-meson region of the Dalitz plot, it is rejected as it destroys agreement in other parts of the Dalitz plot. The scattering matrix for neutral pions in the final state is also presented. (Diss. Abstr. Int., B)

Strong (Baryon No. = 1)

13945 (COO-1195-276) REACTION $\pi^-p \rightarrow \pi^-\pi^-\pi^+p$ AT 25 AND 40 GeV/c. Anitpov, Yu. M.; Ascoli, G.; Busnello, R.; Kienzle-Focacci, M. N.; Kienzle, W.; Klanner, R.; Lebedev, A. A.; Lechanoine, C.; Lecomte, P.; Martin, M.; Roinishvili, V.; Sard, R. D.; Weitsch, A.; Yotch, F. A. (Illinois Univ., Urbana (USA). Dept. of Physics). 1973. 12p. (CONF-730943-9). Dep. NTIS $3.00.

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

The reaction $\pi^-p \rightarrow \pi^-\pi^-\pi^+p$ was measured at 25 and 40 GeV/c at the Serpukhov Proton Accelerator. The production cross section as a function of beam energy, momentum transfer, and 3π mass is presented, and results of the partial-wave analysis of the 3π system are discussed. (auth)

13946 (RLO-2041-98) COMPENDIUM OF DATA ON π^+p AND $pp \rightarrow$ n CHARGED PARTICLES FOR $p_{LAB} \geq 4$ GeV/c. Aubrecht, G. J. II. (Oregon Univ., Eugene (USA). Inst. of Theoretical Science). 1973. Contract AT(45-1)-2230. 20p. Dep. NTIS $3.00.

Available data are compiled on the reactions π^+p and $pp \rightarrow$ n charged particles, with application to KNO scaling. The topological cross sections are tabulated, and the C_q for these reactions deduced from the data ($C_q = \langle n^q \rangle / \langle n \rangle^q$). KNO function, labeled by its laboratory momentum, is presented for all the data. The C_q for $p_{LAB} \geq 50$ GeV/c are presented for comparison with the predictions of various models. (auth)

13947 UPPER BOUND FOR THE SUM OF π^+p AND π^-p TOTAL CROSS SECTIONS ABOVE 60 GeV. Pham, T.N.; Truong, T.N. (Centre de Physique Théorique de l'Ecole Polytechnique, 75230 Paris Cedex 05, France). Phys. Rev. Lett. 31: No. 5, 330-332 (30 July 1973).

Using available experimental data, we give an upper bound for the sum of $\sigma_{tot}(\pi^+p)$ and $\sigma_{tot}(\pi^-p)$ above 60 GeV. It rules out an appreciable increase of this sum beyond 60 GeV. (auth)

13948 COMPILATION OF COUPLING CONSTANTS AND LOW ENERGY PARAMETERS. Pilkuhn, H. (Kernforschungszentrum, Karlsruhe, Ger.); Schmidt, W.; Martin, A. D.; Michael, C.; Steiner, F.; Martin, B. R.; Nagels, M. M.; de Swart, J. J. Nucl. Phys.; B65: No. 2, 460-517(1973).

General formulas and definitions are first given. A compilation of coupling constants and low-energy parameters are given for πN, KN, $\bar{K}N$, $\pi\epsilon$, $\pi\Lambda$, NN, YN, and meson-meson scattering. Regge residues, electromagnetic interactions, SU(3) comparison and predictions are also discussed. (LBS)

13949 BOUNDS ON THE ZEROS OF POMERON AMPLITUDES. Hahn, B. D. (Cavendish Lab, Cambridge, Eng.); Hodgkinson, D. P. Lett. Nuovo Cim.; 8: No. 13, 820-824(24 Nov 1973).

Two lower bounds on the imaginary part of a nonflip elastic amplitude were previously obtained, one under the assumption that the impact parameter profile a(b) is a monotonically decreasing function of b, and the other under the same conditions except that the monotonicity constraint is replaced by the condition that the amplitude should have a given value of the elastic cross section. The two bounds are compared and contrasted with the one obtained by the union of their constraints. Using the improved bound it is predicted that under very general conditions the imaginary pomeron amplitude A(t) has no zero in the range $0 \leq -t \leq 0.56$ (GeV/c)^2 for π^+p scattering at 16.7 GeV/c, and no zero in the range $0 \leq -t \leq 0.63$ (GeV/c)^2 for K^+p scattering at 14.8 GeV/c. (LBS)

13950 SOME PROPERTIES OF THE FORWARD $\pi N \rightarrow \pi N$ SCATTERING AMPLITUDES. Wit, R. (Jagellonski Univ., Krakow). Zesz. Nauk. Uniw. Jagiellon., Pr. Fiz.; 329: No. 11, 7-36(1973).

Some relations which must be satisfied by the forward $\pi N \rightarrow \pi N$ scattering amplitudes are discussed. The first part of these relations is based only on analyticity, crossing symmetry and the optical theorem, whereas in the derivation of the second part some additional assumptions (suggested by the experimental data) are involved. It appears that some of these relations are very useful when testing the recently proposed models for the high energy elastic scattering. Also the validity of the Pomeranchuk theorem is discussed here in some detail. A fairly extensive numerical analysis seems to indicate that this theorem holds. Finally, we suggest further applications of the presented approach in the high energy analysis of the forward scattering amplitudes. (auth)

13951 STRUCTURAL MODELS OF ELECTRON AND NUCLEON IN GENERAL RELATIVITY. Burcev, P. (Purkyne Univ., Brno). Czech. J. Phys.; 23: No. 11, 1172-1180(1973).

Using the interior Schwarzschild's solution, Nordström's solution and the approximative solution of Einstein's equations with the energy-momentum tensor of scalar mesonic field the structural models of electromagnetically and strongly interacting stable particles are constructed. The models represent the equilibrium configuration of the structures described by the interior Schwarzschild's solution, the gravitational and electric or mesonic field and their parameters correspond to those of electron and nucleon. (auth)

13952 REACTIONS INVOLVING A VECTOR MESON PRODUCED IN ASSOCIATION WITH THE $\Delta(1236)$ OR NUCLEON. Ciapetti, G. (CERN, Geneva); Eisner, R. L.; Irving, A. C.; Kinson, J. B.; Watkins, D. C. Nucl. Phys.; B66: 350-367(1973).

To understand better the production mechanism responsible for the vector meson density matrix elements and production angular distributions recently obtained in an analysis of $K^+p \rightarrow K^{*0}\Delta^{++}$ from 4.6 to 16 GeV/c, a comparison is made with the reactions $\pi^+p \rightarrow (\rho^0, \omega)\Delta^{++}$ and $K^-n \rightarrow K^{*0}\Delta$. In particular, the properties of K^- and K^+ induced $K^*\Delta$ production are qualitatively understood in terms of the $\rho\Delta$ and $\omega\Delta$ production data via an SU(3) sum-rule. The corresponding nucleon production data are also investigated. Implications for the extraction of $K\pi$ phase shifts are noted and some comments and recommendations on the extraction of resonance cross sections are made. (auth)

13953 QUASI-TWOBODY REACTIONS WITH THE LARGE HELICITY FLIP AS THE TESTS FOR CUTS GENERATION. Macek, W. (Univ., Warsaw). Bull. Acad. Pol. Sci., Ser. Sci., Math., Astron. Phys.; 21: No. 7, 643-648(1973).

The problem whether the scattering amplitudes f(n) for reaction with a large helicity flip (n) have zeros at the wrong signature points (the weak cuts) or rather at the zeros of the Bessel functions (the strong cuts-geometry) is examined. The following reactions: $\pi N \rightarrow \rho\Delta$, $\pi N \rightarrow fN$, $\pi N \rightarrow f\Delta$, were examined, and it was found that the existing data seem to indicate that the geometry is right for Im f(n). Also other possible rules are proposed. (auth)

Strong (Baryon No. ≥ 2)

Refer also to abstracts 14140 and 14294.

13954 (BNL-18335) PROCEEDINGS OF THE SUMMER STUDY MEETING ON NUCLEAR AND HYPERNUCLEAR PHYSICS WITH KAON BEAMS, BROOKHAVEN NATIONAL LABORATORY, UPTON, NEW YORK, JULY 2-6, 1973. Palevsky, H. (ed). (Brookhaven National Lab., Upton, N. Y. (USA)). 1973. 333p. (CONF-730722-). Dep. NTIS $18.75.

The conference included 13 papers, one of which was abstracted previously in NSA as 28: 23044. Separate abstracts were prepared for 12 papers. (JFP)

For abstracts of individual papers see: 13310, 13738, 13739, 13823-13825, 13955-13958, 14173, and 14294.

13955 (BNL-18335, pp 1-63) HYPERNUCLEAR PHYSICS AND ITS IMMEDIATE PROBLEMS. Dalitz, R. H. (Oxford Univ.). 1973.

From conference on nuclear and hypernuclear physics with kaon beams; Upton, New York (2 Jul 1973).

In proceedings of the summer study meeting on nuclear and hypernuclear physics with kaon beams.

The topics discussed include the present data, theoretical notions about the nuclear interactions of the lambda particle, the interpretation of p- and s-shell hypernuclear data, the lambda particle in nuclear matter, and excited hypernuclear states. (JFP)

13956 (BNL-18335, pp 64-91) A WELL DEPTH. Bodmer, A. R. (Argonne National Lab., IL). 1973.

From conference on nuclear and hypernuclear physics with

kaon beams; Upton, New York (2 Jul 1973).

In proceedings of the summer study meeting on nuclear and hypernuclear physics with kaon beams.

The problem of the Λ well depth D (the Λ-particle binding in nuclear matter) is discussed, in particular the results of reaction-matrix calculations of D. Such calculations were made for a wide range of central, repulsive-core potentials, and also for more complicated OBE interactions with ΛN tensor forces and coupling between the ΛN and ΣN channels. The calculated and phenomenological well depths are compared and the implications for the ΛN interactions are considered. (auth)

13957 (BNL-18335, pp 147-184) STRANGENESS EXCHANGE RESONANCES. Lipkin, H. J. (National Accelerator Lab., Batavia, IL). 1973.

From conference on nuclear and hypernuclear physics with kaon beams; Upton, New York (2 Jul 1973).

In proceedings of the summer study meeting on nuclear and hypernuclear physics with kaon beams.

The discussion covers common nuclear excitations, symmetries and models in strangeness-changing reactions, kinematics, impulse approximations, and selection rules in the reaction mechanism, dynamics of the decay process, Sakata SU(3) symmetry, and sigma hypernuclear states. (JFP)

13958 (BNL-18335, pp 307-315) NUCLEAR OPTICAL POTENTIAL FOR LOW ENERGY KAONS. Wycech, S. (Inst. for Nuclear Research, Warsaw). 1973.

From conference on nuclear and hypernuclear physics with kaon beams; Upton, New York (2 Jul 1973).

In proceedings of the summer study meeting on nuclear and hypernuclear physics with kaon beams.

Several approaches to the problem of the effective kaon-nucleus potential are reviewed. (JFP)

13959 (COO-535-693, pp 69-70) GLAUBER CALCULATION OF PION-DEUTERON SCATTERING. Rosenthal, A.; Peterson, R. J. 1 Nov 1973.

In Nuclear Physics Laboratory technical progress report, November 1, 1972-November 1, 1973.

13960 (ITF-73-106-P) MODIFICATION OF THE FADDEEV EQUATIONS FOR THE MODEL SYSTEMS WITH COULOMB INTERACTION. Veselova, A. M. (AN Ukrainskoj SSR, Kiev, Inst. Teoreticheskoj Fiziki). 1973. 19p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

Three-particle integral equations modified previously for the Coulomb interactions are applied to two physical systems: electron-negative ion scattering and p-d scattering. The short-range interactions are taken in separable form. Some integrals entering the kernels of these equations are calculated explicitly. (auth)

13961 (JINR-P2-7395) PROPAGATION OF FAST NUCLEAR PARTICLES IN ATMOSPHERE. Barashenkov, V. S.; Sdobnov, V. E.; Chigrinov, S. E. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1973. 12p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The Monte-Carlo method developed for calculating the penetration of the fluxes of high-energy nuclear particles through dense media is applied to an extended gaseous medium. The calculated results are compared with experimental data and other calculations, which is illustrated by the interactions of cosmic rays with the earth's atmosphere. (auth)

13962 INTERFERENCE TERMS AND THE MULTIPERIPHERAL OVERLAP INTEGRAL. Teper, M. (Westfield Coll., London). Lett. Nuovo Cim.; 8: No. 16, 929-932(15 Dec 1973).

It has been emphasized that the contribution of the standard multiperipheral model to s-channel unitarity would imply a forward logarithmic slope for the elastic pp amplitude which grows much faster with energy than is actually observed to be the case. It is suggested that the problem may be largely the result of neglecting interference terms in the overlap integral. An analog model is constructed, which leads to a reduction in the forward logarithmic slope by a factor of ¾. (LBS)

13963 MULTIPLICITY DISTRIBUTIONS IN PROTON-PROTON COLLISIONS. Wroblewski, A. (Univ., Warsaw). Acta Phys. Pol.; B4: No. 6, 857-884(1973).

General features of the multiplicity distributions in proton-proton collisions are critically analyzed. (auth)

13964 NEW SCALING VARIABLE FOR PRONG NUMBER DISTRIBUTIONS IN HADRON COLLISIONS. Rama Rao, L; Sarma, K. V. L. (Tata Inst. of Fundamental Research, Bombay). Lett. Nuovo Cim.; 8: No. 16, 963-967(15 Dec 1973).

A new scaling variable $\eta = n(n-1)/\langle n(n-1)$ is introduced, where n is the prong number in inelastic hadron collisions. It is shown for pp data that η appears to be a better scaling variable than W for the description of the multiplicity distribution of secondary particles. (LBS)

13965 SCALING, MULTIPLICITY DISTRIBUTIONS AND CONSERVATION OF ISOSPIN IN AN UNCORRELATED JET MODEL. Ruijgorok, T. W.; Schlitt, D. W. (Univ. of Utrecht). Acta Phys. Pol.; B4: No. 6, 953-972(1973).

A simple model for uncorrelated meson production in p-p collisions is extended to include exact conservation of isospin. The correlations between charged particles are so strongly enhanced that the width of the charged particle distribution becomes proportional to the average charged particle multiplicity. For high energies the multiplicity distribution has an energy independent scaling behavior. In the limit of infinite energy this scaling is of the type predicted by Koba, Nielsen and Olesen. The scaling function is singular at a certain value of $N_c/\bar{N}_c$ and beyond this point it vanishes exactly. For large, but not infinite, values of $\bar{N}_c$ the maximum in the topological cross-sections occurs for $N_c\bar{N}_c$ near this singular point. The value of the maximum cross section behaves like $\bar{N}_c^{4}\sigma_{inel}$. The model is compared with the results of recent experiments. (auth)

13966 STRUCTURES IN THE PROTON-PROTON ELASTIC CROSS SECTION AND TWO COMPONENTS OF THE POMERON. Swiecki, M.; Wilk, G. (Inst. of Nuclear Research, Warsaw). Lett. Nuovo Cim.; 8: No. 15, 905-909(8 Dec 1973).

Two energy-dependent structures have been observed in proton-proton elastic cross sections at ISR energies-namely, the change of slope of the diffraction peak in the form of a break at $t \simeq -0.15$ (GeV/c)^2, and the dip at $t \simeq -1.3$ (GeV/c)^2. Arguments are presented in favor of a unique explanation of both phenomena, under the assumptions that the central distribution of the protonic matter is given as in the Chou-Yang model with the form factor independent of the energy, and that the energy-dependent component of the pomeron has the form of a moving simple Regge pole. The low-momentum-transfer and high-momentum-transfer behavior of the elastic pp scattering at 1480 GeV/c are calculated and compared with experiment. It is concluded that the results of the present work support the idea of two components of the pomeron with the central component independent of the energy. (LBS)

13967 MULTIPLICITY DISTRIBUTIONS AND RISING CROSS SECTIONS IN p-p SCATTERING. Minami, S. (Osaka City Univ.). Lett. Nuovo Cim.; 8: No. 12, 729-734(17 Nov 1973).

It is shown that experimental data for the multiplicity distributions in p-p scattering can be explained well by taking into account the effect of an increase of cross section in the ISR energy range. (LBS)

13968 REAL PART OF THE pp AMPLITUDE AND RISING CROSS SECTIONS. Joynson, D. W.; von Schlippe, W. (Westfield Coll., London). Nucl. Phys.; B65: No. 2, 333-345(1973).

The new experimental evidence of a rising pp total cross section (σ_{pp}) makes it necessary to recalculate the real part of the forward scattering amplitude, which previously has been calculated assuming $\sigma_{pp} \to$ constant asymptotically. The results of dispersion relations calculations of the real part at all energies are presented, with various assumptions about the asymptotic behavior of both σ_{pp} and $\sigma_{\bar{p}p}$, consistent with the latest experimental data. (auth)

13969 SINGLE MUON DISTRIBUTION IN $pp \to \mu^-\mu^+ +$ HADRONS. Evans, K. J. (Cambridge Univ., Eng.). Nucl. Phys.; B65: No. 2, 540-543(1973).

The single muon distribution for the process $pp \to \mu^-\mu^+ +$ hadrons is considered. It is observed that the calculation of $d\sigma/d^3K$ for the differential cross section of one of the muons, where the momentum of the other muon is integrated out, is almost as simple as that for $d\sigma/dq^2$. (auth)

13970 EFFECT OF THE FINITE πN-INTERACTION RANGE ON πd-SCATTERING LENGTH. Petrov, N. M.; Peresypkin, V. V. (Inst. of Theoretical Physics, Kiev). Yadern. Fiz.; 18: No. 4, 891-794(Oct 1973). (In Russian).

The πd-scattering length is calculated using the formalism of Faddeev's integral equations. Nucleon-nucleon and pion-nucleon interactions are described by a potential with separable variables in the S-state. The dependence of the πd-scattering length on the shape of the attractive nucleon-nucleon central potential and on the value of the effective range of pion-nucleon interaction is studied. (auth)

13971 FLUID ANALOG IN HIGH ENERGY pp COLLISIONS. Tanaka, K.; Ueda, Y. (Inst. of Theoretical Physics, Goteborg). Nucl. Phys.; B66: 505-517(1973).

The generating functions which represent the pp data from

50 to 303 GeV/c were used as analog grand partition functions and the notions of analog pressure, specific volume, equation of state and critical point were explored. l-plane singularities are discussed in this connection. Present empirical fits do not seem to support the occurrence of a phase transition in the hadronic fluid. (auth)

13972 POSSIBLE SPIN EFFECTS IN pp SCATTERING AT HIGH ENERGIES AND THE $X^0(960)$ MESON. Buyak, A.; Zaslavskii, A.N.; Ogievetskii, V. I.; Filippov, A. T. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 18: No. 4, 894-898(Oct 1973). (In Russian).

Possible Regge trajectory of the $X^0(960)$ meson is discussed if its spin-parity is 2^-. In this case X-trajectory will have the intercept $\alpha(0) = 1$, the same as for the Pomeranchuk's one. Such an unexpected possibility can not be excluded by the available data. The X-trajectory exchange leads to spin effects in elastic pp scattering at super-high energies which can be responsible for the variation of the slope parameter observed recently in ISR experiment. (auth)

13973 FORMATION OF HEAVY CLUSTER AND PROPERTIES OF TOPOLOGICAL CROSS SECTIONS OF PROTON–PROTON INTERACTIONS. Takibaev, Zh. S.; Usik, P. A. (Inst. of High Energy Physics, Serpukhov, USSR). Yadern. Fiz.; 18: No. 4, 899-901(Oct 1973). (In Russian).

Some arguments are given in favor of the fact that the production of a heavy cluster (supercluster) is the principle process in inelastic pp interactions at energies higher than 10^{11} eV. It is shown that if the supercluster formation is considered using the OME model with a formfactor in the nucleon vertex and the supercluster decay is considered in the exact one-dimensional approximation of the hydrodynamical model of multiple-particle production, then one can interpret the observed properties of the topological cross sections of pp interaction at the incident momenta 205 and 303 GeV/c. (auth)

13974 FAMILY OF SOLUTIONS OF THE NEUTRON–PROTON ELASTIC UNITARITY EQUATIONS. Alvarez–Estrada, R. F. (Universidad Autonoma de Madrid); Carreras, B.; Goni, M. A. Nucl. Phys.; B66: 518-534(1973).

The determination of the elastic neutron–protron amplitudes from feasible complete experiments is considered. The study is limited to the very low energy region. (auth)

13975 ELASTIC PROCESSES AT LARGE MOMENTUM TRANSFER. Hughes, R. P. (Cambridge Univ., Eng.). Nucl. Phys.; B66: 189-209(1973).

A covariant version of the composite model of Blankenbecler, Brodsky and Gunion for electromagnetic form factors at large momentum transfer is developed paying particular attention to gauge invariance for which a general condition is derived. It is found that the asymptotic behavior of the form factor is dominated by the current interacting with partons which carry nearly all the longitudinal momentum of their parent hadron. The theory is then specialized to the particular model of Blankenbecler, Brodsky and Gunion and a natural Bethe–Salpeter model for the hadron-parton-core vertex is introduced. Spin is then included and the asymptotic behavior of the pion and nucleon form factors is derived. Elastic proton–proton scattering at large momentum transfer is then discussed. (auth)

13976 CHARGE DISTRIBUTIONS IN INELASTIC PROTON–PROTON COLLISIONS. Bonn-Hamburg-Muechen Collaboration. Nucl. Phys.; B67: No. 1, 93-124(1973).

Charge distributions for the secondaries from inelastic proton–proton collisions are studied by means of new data from an experiment at 12 and 24 GeV/c (2 m HBC at CERN). By comparison with π^+p data at 16 GeV/c, the inclusive charge distributions for the fragments of an incident proton and pion, respectively, are analyzed. In addition, the cross sections for charge exchange between cms hemispheres are presented for the various charged-particle multiplicities. For events with no more than one neutral particle, charge and baryon exchange between cms hemispheres are compared to those between clusters. For the inelastic two-prong reactions, the two-dimensional distributions in longitudinal phase space are presented. (auth)

Particle Invariance Principles and Symmetries

General

Refer also to abstracts 14514 and 14515.

13977 REMARKS ON SOME NONUNITARY REPRESENTATIONS OF THE POINCARE GROUP. Iacopini, E. (International Centre for Theoretical Physics, Trieste, Italy). Nuovo Cim.; 18A: No. 2, 205-236(21 Nov 1973).

A class of reducible but indecomposable representations of the Poincaré group, characterized by real masses and momenta is analyzed. The nonunitary character of these representations is reflected in the fact that the momentum eigenvectors no longer form a generalized basis for the representation space. A formalism is set up, which, through the introduction of a basis consisting of eigenvectors and eigenghosts of the momentum operators, allows these representations to be analyzed and discussed in a way very close to the standard. This formalism is then applied to the discussion of field theories defined by weak equations of motion of the form $(\Box + m^2)^n$, $m^2 \geq 0$, $n \geq 1$, and the most general bilinear forms (commutators, two-point functions, etc.) consistent with the representation are obtained. Some peculiarities of the zero-mass case are also exhibited. (auth)

13978 FINITE TRANSFORMATION OF SU(4). Basu, B. K.; Majumdar, S. D. (Indian Inst. of Tech., Kharagpur). Czech. J. Phys.; 23: No. 11, 1149-1158(1973).

The problem of determining the representation matrices of SU(4) is investigated. A convenient set of parameters is first introduced by writing the general element of the group as a product of exponential functions of the generators, and the generators are expressed as differential operators involving these parameters. Special matrix elements of finite transformations with a SU(3) singlet as the initial state are then obtained by solving the eigenvalue equation of the quadratic Casimir operator of SU(4). The solution has the form of a product of elementary functions and three $d^j_{m',m}$ functions of SU(2) and is free from summation over intermediate states. By expanding one of the $d^j_{m',m}$ functions in an appropriate series a sum rule for the special matrix elements of the permutation operator $1234 \rightarrow 3412$ is obtained. The discussions are strictly confined to SU(4), but, some of the results given here can be extended to unitary groups of higher dimensions. (auth)

13979 REMARK ON BARYON CONSERVATION. Pais, A. (Rockefeller University, New York, New York 10021). Phys. Rev. D 8: No. 6, 1844-1846 (15 Sept 1973).

The Higgs mechanism can serve to implement baryon conservation via an extension of the local weak–electromagnetic gauge group by a local factor U(1) without conflict with the Eötvös experiments. (auth)

13980 COMMENT ON BROKEN SCALE INVARIANCE. Andrei, N.; Gomberoff, L. (Department of Physics and Astronomy, Tel-Aviv University, Ramat Aviv, Israel). Phys. Rev. D 8: No. 6, 1922-1924 (15 Sept 1973).

Broken scale invariance is briefly reviewed. A constraint on the equal-time commutator between the trace of the energy–momentum tensor and symmetry–breaking terms is discussed. A sum rule relating matrix elements of chiral-symmetry–breaking terms with their dimensions is derived. (auth)

13981 GOLDSTONE BOSONS IN CHIRAL SU(4) × SU(4). Dittner, P.; Eliezer, S. (Department of Physics, Imperial College, Prince Consort Road, London SW7, England). Phys. Rev. D 8: No. 6, 1929-1932 (15 Sept 1973).

We suggest an approximate chiral SU(4) × SU(4) symmetry for the strong Hamiltonian with the vacuum only SU(3) -invariant in the symmetry limit. Two exact sum rules are obtained. Within this scheme both chiral SU(2) × SU(2) and SU(3) are good symmetries. (auth)

13982 BOOSTING MATRIX ELEMENTS FOR THE REDUCTION O(3,1) CONTAINS O(2,1) CONTAINS O(2). Smorodinskii, Ya. A.; Shepelev, G. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 18: No. 4, 934-943(Oct 1973). (In Russian).

Expressions for the boosting matrix elements of representations belonging to the principal series in case of the reduction $O(3,1) \supset O(2,1) \supset O(2)$, are obtained; their certain properties are studied. (auth)

13983 BJORKEN SCALING AND SCALE-INVARIANT QUANTUM FIELD THEORIES. Schroer, B. (Freie Univ., Berlin). pp 43-57 of Scale and Conformal Symmetry in Hadron Physics. Gatto, R. (Ed.). New York; John Wiley and Sons, Inc. (1973).

From scale and conformal symmetry in hadron physics meeting; Frascati, Italy (4 May 1972). See CONF-7205101-.

The usefulness of conformal invariance in connection with the Bjorken scaling law is first discussed. The normal product algorithm and its applications for deriving conformal symmetry is then introduced. The use of the normal product algorithm for studying the scale properties of the short-distance expansion as postulated by Wilson is the examined. (LBS)

13984 GENERAL CONSEQUENCES OF CONFORMAL ALGEBRA. Ferrara, S. (CNEN, Rome); Gatto, R.; Grillo, A. F.; Parisi, G. pp 59-108 of Scale and Conformal Symmetry in Hadron

Physics. Gatto, R. (Ed.). New York; John Wiley and Sons, Inc. (1973).

From scale and conformal symmetry in hadron physics meeting; Frascati, Italy (4 May 1972). See CONF-7205101-.

A series of results that follow from conformal algebra is summarized. The implications of covariance under the conformal algebra on the leading light cone singularities are discussed in terms of operator product expansions. The restrictions of conformal algebra on vacuum expectation values are given. Two-point and three-point functions are intimately connected to the conformal covariant operator product expansion. The restrictions on the four-point function are separately dealt with. The theorem of canonical scaling and its implications are discussed. Finally, the special situation occurring in two space-time dimensions is examined. (LBS)

13985 CONFORMAL SYMMETRY IN WILSON OPERATOR PRODUCT EXPANSIONS. Bonora, L.; Ciccariello, S.; Sartori, G.; Tonin, M. (Univ., Padua). pp 131-137 of Scale and Conformal Symmetry in Hadron Physics. Gatto, R. (Ed.). New York; John Wiley and Sons, Inc. (1973).

From scale and conformal symmetry in hadron physics meeting; Frascati, Italy (4 May 1972). See CONF-7205101-.

A conformal covariant Wilson operator product expansion of two general tensor local operators is discussed. The representation is considered as a generalization of a previous one obtained by Ferrara, Gatto, and Grillo. (LBS)

13986 SCALING PROPERTIES OF INFINITE-COMPONENT FIELDS. Kleinert, H. (Freie Univ., Berlin). pp 183-212 of Scale and Conformal Symmetry in Hadron Physics. Gatto, R. (Ed.). New York; John Wiley and Sons, Inc. (1973).

From scale and conformal symmetry in hadron physics meeting; Frascati, Italy (4 May 1972). See CONF-7205101-.

It is shown that structure functions with finite scaling limits can be calculated within the framework of an infinite-component model. It is also shown that the infinite-component wave equations can serve as useful models for the study of the interrelation of infinity rising resonance structures, light-cone properties, and the parton picture of deep inelastic scaling phenomena. (LBS)

13987 SOME ASTROPHYSICAL SPECULATIONS AT VERY HIGH ENERGIES. Kastrup, H. A. (Inst. of Theoretical Physics, Aachen). pp 213-225 of Scale and Conformal Symmetry in Hadron Physics. Gatto, R. (Ed.). New York; John Wiley and Sons, Inc. (1973).

From scale and conformal symmetry in hadron physics meeting; Frascati, Italy (4 May 1972). See CONF-7205101-.

Properties of distribution functions for systems with dilatation or conformally invariant binary collisions are first discussed. Several high-energy processes which might have led to conformal distribution functions are then discussed. (LBS)

Applications (Electromagnetic and Weak)

Refer also to abstracts 12800 and 14217.

13988 CAUSALITY AND SCALING RESTRICTIONS ON THE ELECTROMAGNETIC EQUAL-TIME COMMUTATORS. Taha, M. O. (Univ. of Khartoum, Sudan). Nucl. Phys.; B66: 245-252 (1973).

Causality restricts the Fourier transform E_{0k} of the electromagnetic equal-time commutators between spinless states of equal-momenta p to the form $E_{0k} = -p \cdot q\, S_2 p_k + (S_1 + pqS_2)q_k$, where S_1 and S_2 are constants. If W_1 scales, $S_1 = 1/4\pi \int {}^F L(\omega)/\omega^2\, d\omega$. If ν W_2 scales, $S_2 = 0$. The connection between equal-time and light-cone causality sum rules is discussed. (auth)

13989 NONLINEAR CHIRAL MODEL AND THE RATIO f_K/f_π. Ilyin, Yu. M.; Sabo, V. Ya. (Inst. for Theoretical Physics, Kiev). Lett. Nuovo Cim.; 8: No. 12, 758-760(17 Nov 1973).

A nonlinear chiral model which incorporates 0^-, 1^1 mesons is considered. The symmetry breaking is introduced by the covariant method and is shown to lead to the experimentally confirmed value $f_K/f_\pi = 1.17$. (LBS)

Applications (Strong)

Refer also to abstracts 13929 and 13964.

13990 SCALE AND CONFORMAL SYMMETRY IN HADRON PHYSICS. Conference Held at Rome, Italy, May 4-5, 1972. Gatto, R. (ed.). New York; John Wiley and Sons, Inc. (1973). 237p. (CONF-7205101-).

Eleven papers are included, a separate abstract is prepared for each paper. (LBS)

For abstracts of individual papers see: 13895-13897, 13931, 13983-13987, 14527, and 14561.

Scattering Theory

Refer also to abstract 14307.

13991 (CISE-N-164) FRONTAL SOLUTION: A PROGRAMMING TECHNIQUE FOR GAUSSIAN ELIMINATION ALGORITHM APPLIED TO LARGE-DIMENSION SCATTERED MATRICES. Giorcelli, M. (Centro Informazioni Studi Esperienze, Milan (Italy)). Sep 1973. 32p. (In Italian). Dep. NTIS (U.S. Sales Only) $3.75.

The frontal solution technique is particularly useful in the solution of systems whose elements are formed by the superposition of successive blocks, as is found in finite element discretization. This technique is based on the Gaussian elimination algorithm and is characterized by the fact that the matrix elements are formed between the diverse elimination steps. The basic techniques used in the solution of systems with scattering matrices are summarized. The frontal solution technique is then described. The characteristic discretization method for the finite elements of positive definite operators is described, and the methods normally used for their solution are outlined. Because the problem of the treatment of scattering matrices is essentially a problem of good coding, special attention is given to the coding technique. (JSR)

13992 (IFVE-STF-73-23) SINGLE-TIME EQUATION FOR PARTICLE SCATTERING ON BOUND STATE IN QUANTUM FIELD THEORY. Arkhipov, A. A.; Savrin, V. I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii). 1973. 27p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.50.

It is shown, in what a way the single-time formulation of relativistic many-body problem leads to a quasipotential equation for two particle scattering, one of which is the bound state of two other particles. Effective potential of such an interaction is expressed through pair interaction quasipotentials and through quasipotential, which does not come to the pair ones. (auth)

13993 (SLA-73-7076) TIME-INDEPENDENT MULTICHANNEL SCATTERING THEORY FOR CHARGED PARTICLES. Gibson, A. G.; Chandler, C. (New Mexico Univ., Albuquerque (USA)). 1973. Contract 51-6640. 50p. Dep. NTIS $4.50.

For Sandia Labs., Albuquerque, NM.

Rigorous derivations are given of two time-independent formulas for the multichannel scattering operator for nonrelativistic charged particle systems. The derivations are based on Dollard's time-dependent theory and use techniques of spectral integration. The formulas involve a complex power of the resolvent operator, in contrast to short-range formulas. Bilateral Laplace transforms are used to derive a generalized multichannel resolvent equation and to prove existence and uniqueness of the solution. The formulas are applied to recover the well known two-body Coulomb scattering amplitude. (auth)

13994 ASYMPTOTIC SERIES FOR THE SCATTERING OPERATOR AND ASYMPTOTIC UNITARITY OF THE SPACE CUT-OFF INTERACTIONS. Albeverio, S.; Hoegh-Krohn, R. (Univ. of Oslo). Nuovo Cim.; 18A: No. 2, 285-307(21 Nov 1973).

The asymptotic expansions in powers of the coupling constant λ for the asymptotic fields and the scattering operator S for self-coupled boson fields with space cut-off polynomial interaction in two space-time dimensions are constructed. These asymptotic expansions are then used to prove that $S^*S = SS^* = 1$ in the sense of asymptotic power series in λ on a dense set of states. The results apply also, under the additional assumption of an ultraviolet cut-off, to large classes of boson-boson, fermion-boson and fermion-fermion interactions as well as to boson nonpolynomial interactions (in all space-time dimensions). (auth)

13995 NEW DISPERSION RELATIONS AND THEIR APPLICATION TO PARTIAL-WAVE AMPLITUDES. Hite, G. E. (Universitaet Trier-Kaiserlautern, Ger.); Steiner, F. Nuovo Cim.; 18A: No. 2, 237-270(21 Nov 1973).

After reviewing the commonly used dispersion relations, a systematic investigation of more generalized dispersion relations on parametrized curves in the Mandelstam plane for s-u crossing-symmetric amplitudes is made with the aim of obtaining dispersion relations which receive contributions from all three channels, however, in such a way that knowledge of the absorptive parts is only required in regions well inside the various Lehmann ellipses. In addition it is required that the dispersion relations receive no contributions from kinematic singularities arising from the parametrization and that they allow partial-wave projections to be made in a relatively simple manner. It is found that dispersion relations on hyperbolic curves in the Mandelstam plane are a natural solution of the problem. The dispersion relations are written in a remarkably simple form similar to the usual fixed-t dispersion relation but with an additional t-channel contribution. As an

interesting application, generalized partial-wave dispersion relations are derived for elastic pion-nucleon scattering, where the left-hand cut contribution is explicitly given by convergent partial-wave series in the crossed channels. (auth)

13996 BOUND STATES AT INFINITE MOMENTUM AND THE BETHE–SALPETER EQUATION. Jaroszewicz, T. (Inst. of Nuclear Physics, Krakow). Lett. Nuovo Cim.; 8: No. 15, 900-904 (8 Dec 1973).

The properties of the wave function interpreted as the $x_+ = 0$ section of the four-dimensional Bethe–Salpeter amplitude are studied. Arguments are offered in favor of the hypothesis that this light-plane wave function may closely resemble the corresponding Schroedinger wave function, even in the case of strong binding. The consequences of this prescription are discussed, especially Lorentz contraction and recoil effects. It is concluded that the approach provides a useful link between the standard Bethe–Salpeter equation approach and the infinite-momentum-frame parton concepts. (LBS)

13997 REAL WEINBERG FUNCTION AT POSITIVE ENERGY. Efimov, V.; Schulz, H. (Joint Inst. for Nuclear Research, Moscow). Lett. Nuovo Cim.; 8: No. 13, 761-767(24 Nov 1973).

It is pointed out that one of the most effective approaches to obtain a separable representation for the two-body t-matrix is based on the use of the eigenfunction ψ_n of the integral kernel of the Lippmann–Schwinger equation. It is also noted that all eigenfunctions corresponding to positive and negative eigenvalues must be taken into account, which essentially influence the convergence in terms of the so-called real Weinberg functions. These functions are dealt with for positive energies, considering first the exactly solvable case, when $-V$ is an attractive square-well potential, and then the more complicated one, where $-V$ is a potential of the Yukawa type. (LBS)

13998 POWER SERIES, ANALYTICITY, AND CURRENT–HADRON SCATTERING AMPLITUDES. Ahmed, M.A. (Physics Department, University of Khartoum, Khartoum, Sudan). Phys. Rev. D 8: No. 6, 1874-1879 (15 Sept 1973).

We propose to expand the current–hadron scattering amplitude as a double power series in the mass of the current and its laboratory energy. The series is summed by a double Sommerfeld–Watson transformation. Scaling is seen to provide a powerful constraint on the location of singularities in a complex parameter plane associated with the mass variable. (auth)

13999 VARIATIONAL METHODS IN CHARGED-PARTICLE COLLISION THEORY. Rosenberg, L. (Department of Physics, New York University, New York, New York 10003). Phys. Rev. D 8: No. 6, 1833-1843 (15 Sept 1973).

A variational principle of the Kohn type is formulated for the scattering of three charged particles, with particular attention given to the breakup process. In addition, an effective-potential theory, which also allows for variational formulation, is derived for the three-body system with long-ranged Coulomb interactions properly accounted for. These results generalize previous work done for systems with short-ranged interactions; the difference lies, essentially, in the use of Coulomb-modified plane waves to describe the asymptotic states. To establish the physical justification for this modified version of scattering theory a section is included containing a time-dependent description of the collision process in which the wave packets follow classical, Coulomb-modified, trajectories in the initial and final states. (auth)

14000 HIGH-ENERGY EXPANSIONS OF SCATTERING AMPLITUDES. Wallace, S.J. (Lyman Laboratory of Physics, Harvard University, Cambridge, Massachusetts 02138). Phys. Rev. D 8: No. 6, 1846-1863 (15 Sept 1973).

The partial-wave series is converted without approximation to a Fourier–Bessel expansion based on a new (infinite series) expansion for the Legendre function. The direct connection between the Fourier–Bessel phase shift and the partial-wave interpolating phase shift is established as an infinite series in powers of K^{-2} (K = wave number). The series contains the Glauber eikonal approximation as a leading term and reproduces the results of an eikonal expansion about the Glauber propagator. Corrections to the eikonal approximation are developed and rules are given for an unambiguous interpretation of the eikonal expansion. The relativistic eikonal expansion is discussed for forward and backward scattering without small-angle approximations. (auth)

14001 REGGE-SLOPE EXPANSION IN THE DUAL RESONANCE MODEL. Frampton, P.H.; Wali, K.C. (Physics Department, Syracuse University, Syracuse, New York 13210). Phys. Rev. D 8: No. 6, 1879-1886 (15 Sept 1973).

The expansion, in the Regge-slope parameter α', of simplified meson Born amplitudes comprising the Euler B function and its multiparticle generalization is considered in order to proceed towards a Lagrangian density L which goes beyond the zero-slope limit of Scherk. A discussion of the Laurent–Taylor expansion of the four-meson amplitude leads, at least formally, to a Lagrangian density in terms of a scalar field ϕ; this density is, however, nonlocal since it contains an infinite number of derivatives. Certain approximation schemes, in terms of higher-mass poles of the full amplitude, are introduced. Dimensionality arguments applied also to the multiparticle extension lead naturally to the expansion of L in the Regge-slope parameter α'. The full Lagrangian density is given, up to order α'^2 relative to the zero-slope limit. At this order it is necessary to consider only the four- and five-point functions. (auth)

14002 GENERALIZATION OF THE JOST FUNCTION AND ITS APPLICATION TO OFF-SHELL SCATTERING. Fuda, M.G.; Whiting, J.S. (Department of Physics and Astronomy, State University of New York at Buffalo, Buffalo, New York 14214). Phys. Rev. C 8: No. 4, 1255-1261 (Oct 1973).

An off-shell generalization of the Jost function is developed within the framework of the differential-equation approach to the off-shell T matrix. Irregular solutions of the inhomogeneous Schrödinger-like equation that occurs in this approach are introduced, and their behavior at the origin is used to define an off-shell Jost function. The half-off-shell T matrix is expressed directly in terms of the off-shell Jost function. It is shown how the fully off-shell T matrix for a particular partial wave can be expressed simply in terms of a single integral involving the irregular solution for that partial wave. An integral equation for the irregular solution is developed, and used to derive an integral representation for the off-shell Jost function. Iteration of the integral equation leads to a series of successive approximations to the T matrix. The formalism is applied to several examples, including a boundary-condition model. (auth)

14003 COMMENT ON THE EQUIVALENCE OF THE EIKONAL EXPANSION AND INTEGRAL-EQUATION METHODS FOR DETERMINING CORRECTIONS TO THE GLAUBER APPROXIMATION. Wallace, S.J. (Lyman Laboratory of Physics, Harvard University, Cambridge, Massachusetts 02138). Phys. Rev. D 8: No. 6, 1934-1937 (15 Sept 1973).

An eikonal correction derived by Baker from an integral equation valid to order k^{-2} is shown to be equivalent, to the same order, to an eikonal expansion of the scattering T matrix based on expansion of the momentum about the initial momentum $\vec{k}_i$. For nonforward scattering, the inherent differences between an eikonal expansion about $\vec{k}_i$ and an eikonal expansion about the average-momentum $\vec{k} = (1/2)(\vec{k}_i + \vec{k}_f)$ direction explain the inequivalence noted by Baker between his result "rotated" to the average-momentum direction and the result of an eikonal expansion starting from the average-momentum direction. (auth)

14004 CORRECTIONS TO THE GLAUBER SCATTERING AMPLITUDE. Baker, A. (Lowell Technological Institute, Department of Physics and Applied Physics, Lowell, Massachusetts 01854). Phys. Rev. D 8: No. 6, 1937-1939 (15 Sept 1973).

Extensions of the eikonal approximation differ most significantly in the means by which velocity symmetry is introduced in the scattering amplitude. One can either employ a manifestly symmetric representation at the outset, or follow Glauber's lead in choosing the incoming momentum direction for the plane wave; if the latter course is followed, then restoration of symmetry by a coordinate rotation is an essential step, and should not be thought of as an auxiliary approximation. Moreover, physical considerations that go beyond the mathematically prescribed order of calculation underlie the success of this approximation, and offer clues to the most effective means for generating corrections. (auth)

14005 LORENTZ CONTRACTION AND DIFFRACTIVE EXCITATION. Bell, J. S. (CERN, Geneva). Nucl. Phys.; B66: 293-304(1973).

The formalism of light-plane wave functions is applied to the problem of diffractive excitation. Suggestions in the literature, for removing an experimentally embarrassing forward zero in the single scattering approximation to Glauber theory, are not borne out. (auth)

14006 ASYMPTOTIC BEHAVIOR OF THE SCATTERING AMPLITUDE PHASE. Medvedev, S. Yu. (Inst. of Theoretical Physics, Kiev). Yadern. Fiz.; 18: No. 4, 926-933(Oct 1973). (In Russian).

The relations are obtained connecting the asymptotic behavior of the scattering amplitude phase with the dimension of the energy dependence of the amplitude in the asymptotic region. The method used is based on application of Meyman theorem 3. In addition to the general properties of the scattering amplitude certain restrictions are imposed on its possible oscillations on the real axis in the asymptotic region. (auth)

14007 CONSTRUCTION OF A UNITARY ANALYTIC SCATTERING AMPLITUDE. II. Introduction of Spin and Isospin (Spin 0–Spin $\frac{1}{2}$). Atkinson, D. (Instituut voor Theoretische Natuurkunde, Groningen, Netherlands); Mahoux, G.; Yndurain, F. J. Nucl. Phys.; B66: 429-463(1973).

A previous investigation into the existence, uniqueness, and construction of unitary, analytic scattering amplitudes that correspond to a given fixed-energy set of observables is extended to the case spin 0-spin ½. At energies below the inelastic threshold, the problem is overdetermined by a complete set of measurements (differential cross sections, polarizations and Wolfenstein parameters for all charge states), indeed it is shown that, under favorable circumstances, a knowledge of a suitable subset of the experimentally independent observables suffices to determine all the amplitudes and therefore all the remaining observables. On the other hand, for energies above the inelastic threshold, the continuum ambiguity that was discussed for scalar particles persists in general, despite the spin and isospin complications. Thus the amplitudes, and so the phase shifts, cannot in general be determined uniquely simply from a knowledge of the observables at a fixed energy. Finally, a calculational scheme for the numerical investigation of the extent of this continuum ambiguity is discussed. (LBS)

14008 IMPACT PARAMETERS: A GEOMETRICAL PICTURE OF INELASTIC SCATTERING. Chang, N. P. (Max-Planck-Institute for Physics and Astrophysics, Munich). Nucl. Phys.; B66: 381-397(1973).

The constraints on the impact-parameter descriptions of arbitrary n-body scattering due to the Lorentz group are shown to take a simple form at very high energies. The produced jet of beam fragmentation products, each with b_i, and x_i, will be centered about the impact parameter b of the incident beam. A geometrical language can be introduced for the description of inelastic scattering and a simple model is proposed based on this picture. The single-fragmentation inclusive cross section is shown to rise as log s if the total cross section rises as log-squared. In a bremsstrahlung-type model, it is shown that an energy-dependent eikonal of the Cheng-Wu type can be compatible with the apparently linear fit to the Wroblewski plot. (auth)

14009 SIGNATURE, FACTORIZATION, AND UNITARITY IN MULTI-REGGE THEORY: THE FIVE-POINT FUNCTION. White, A. R. (CERN, Geneva). Nucl. Phys.; B67: No. 1, 189-231(1973).

The multi-Regge theory of the five-point function from the Sommerfield-Watson approach is developed and the use that can be made of t-channel unitarity is emphasized. Signature is included systematically so that signature phase factors come out naturally and discontinuities can be taken in a straightforward way. A general method is given for defining Froissart-Gribov continuations. Using the unitarity relations they satisfy factorization of the individual helicity amplitudes contributing to Regge pole residues is proved. This is sufficient to prove factorization of the full amplitude and its discontinuities in multi-Regge limits as well as the factorization of discontinuities in helicity-pole limits. Reggeon scattering amplitudes are defined which are continuations of t-channel helicity amplitudes to complex helicity. It is shown that the t-channel unitarity relation for these amplitudes contains an extra term, besides the usual phase-space integral, which vanishes when the trajectory function goes through integer points. A generalized crossing relation is given which relates s- and t-channel reggeon amplitudes. (auth)

14010 MULTICHANNEL LOG-DERIVATIVE METHOD FOR SCATTERING CALCULATIONS. Johnson, B. R. (Ohio State Univ., Columbus). J. Comput. Phys.; 13: No. 3, 445-449(Nov 1973).

A new method for solving multichannel scattering problems is presented. The key to the method is an efficient algorithm for numerically solving the matrix Ricatti equation for the logarithmic derivative of the wave function. Previous calculations on $He^+ - Ne$ collision at 70.9 eV were repeated. (JFP)

14011 CONTINUUM AMBIGUITY IN THE CONSTRUCTION OF UNITARY ANALYTIC AMPLITUDES FROM FIXED-ENERGY-SCATTERING DATA. Bart, G.R. (Mayfair College, Chicago, Illinois 60630); Johnson, P.W.; Warnock, R.L. J. Math. Phys. (N.Y.) 14: No. 11, 1558-1565 (Nov 1973).

The problem of determining the scattering amplitude for a given fixed-energy elastic differential cross section is discussed in the spinless case. We show that when the energy is above the inelastic threshold, one may construct an infinite family of unitary scattering amplitudes, by appropriate variation of the elasticity parameters. These amplitudes are analytic in the cosine of the scattering angle throughout the Lehmann ellipse, and all correspond to the same cross section. Hence, even if the cross section is known exactly, there are infinitely many sets of phase shifts. Similar results have been obtained in earlier work, under conditions (on the cross section and elasticities) which seem to be physically unrealistic. In the present paper, the outstanding unrealistic assumptions are avoided. In particular, a finite number of zeros of the dispersive part are now allowed. Each zero reduces the continuum ambiguity by one elasticity parameter, but leaves infinitely many parameters to be varied independently. (auth)

14012 OPTIMAL ANALYTIC EXTRAPOLATION FOR THE SCATTERING AMPLITUDE FROM CUTS TO INTERIOR POINTS. Ciulli, S. (NORDITA, Copenhagen, Denmark, and Institute for Atomic Physics, Bucharest, Romania); Nenciu, G. J. Math. Phys. (N.Y.) 14: No. 11, 1675-1691 (Nov 1973).

Given a data function together with an error corridor for the scattering amplitude along some finite part of the cuts, one can construct effectively the whole set of analytic functions ("admissible amplitudes"), compatible with these conditions and bounded by a certain number M on the remaining part of the cuts. Depending on the actual value of an important constant ϵ_0 computed from the data function and the bound M, this set may be void. If not, in every point of the cut plane the set of values of the admissible amplitudes fills densely a circle; explicit formulas are given for its radius $\eta(z)$ and center $\hat{f}(z)$, the latter being the best possible estimate for the whole set. In contrast to the linear extrapolation obtained by Poisson weighted dispersion relations, here nonlinear functional methods were used. This paper contains an appendix written by Professor C. Foias, on some functional analytical methods used in connection with the computation of the numerical value of the constant ϵ_0. (auth)

PHYSICS (LOW-TEMPERATURE)

Superfluidity

14013 (ANL-7996, pp 103-107) FUNDAMENTAL STUDIES ON IMPORTANT LIQUIDS. Feb 1973.

In chemistry division annual report, July 1971–June 1972.

14014 (COO-1569-111) CALCULATIONS OF THE GROUND STATE ENERGY AND EXCHANGE INTEGRALS OF CRYSTALLINE ^{3}He. Lim, W. L. (Minnesota Univ., Minneapolis (USA)). Jul 1973. 65p. Dep. NTIS $5.25.

Thesis.

The variational equation is derived and discussed using Jastrow-type wave functions, which are a product of pair wave functions, as the trail wave function. The various approximations used in simplifying the variational equations so as to obtain a form that is possible to solve numerically are discussed also. A Monte Carlo calculation is described using the wave function obtained. Exchange in ^{3}He is discussed. (MHR)

14015 DISPERSION OF FIRST SOUND IN LIQUID HELIUM NEAR THE λ TRANSITION. Thomlinson, W.C.; Pobell, F. (Institut für Festkörperforschung, Kernforschungsanlage, 517 Jülich, W. Germany). Phys. Rev. Lett. 31: No. 5, 283-286 (30 July 1973).

The velocity of first sound in liquid helium has been measured for frequencies between 5.4 and 208 kHz and at temperatures 1 $\mu K < |T_\lambda - T| < 5$ mK. The dispersion u(ω)–u(0) for each frequency shows a single asymmetric peak at T_λ. The Landau–Khalatnikov order-parameter relaxation process alone is not adequate to describe the magnitude or the shape of the dispersion. The maximum of the dispersion remains frequency dependent even at the highest frequencies. (auth)

14016 PROPERTIES OF SUPERFLUID HELIUM BELOW 1.6 DEGREES KELVIN. Brooks, J. S. Eugene, OR; Univ. of Oregon (1973). 242p. University Microfilms Order No. 73-28,581.

Thesis (Ph. D.).

A working semiempirical model is presented which permits the calculation of most of the properties of superfluid helium, and allows a test of the limitations of the Landau model and the application of Bose statistics to the excitations of the liquid. An empirical equation of state which relates the pressure, temperature, and density of the liquid is developed. The cumulative results of inelastic neutron scattering from elementary excitations are examined. Attempts and difficulties in calculating excitation-related properties from neutron data, spectrum representations, and models are reviewed. A new method is presented for representing the excitation spectrum by a finite series expansion in momentum. This series, is found to exhibit the properties of nonlinear dispersion. Problems involving the calculation of thermodynamic properties exactly from the neutron data are investigated, and an effective roton energy gap is developed in order to make progress in the calculations. Alteration of the ground state by the presence of excitations is analyzed, and a distinct difference between phonon and roton contributions to the thermal expansion is found. Many useful tables are given (e.g., density, expansion coefficients, first and second sound velocities, specific heat, entropy, normal fluid density) for temperatures in the range $.10 \le T \le 2.10$ K and pressures in the range $0 \le P \le 2.5$ atm. Comparisons are made between calculated and experimental results. (RWR)

14017 TIME DEPENDENCE OF VORTEX-RING CREATION IN He II. Titus, J.A.; Rosenshein, J.S. (Department of Physics and Astronomy, University of Florida, Gainesville, Florida, 32601). Phys. Rev. Lett. 31: No. 3, 146-149 (16 July 1973).

Measurements of vortex-ring current created by ions in pulsed electric fields of durations ranging from 10^{-6} to 10^{-4} seconds were made in a temperature range of 0.55 to 0.70 K. The results show that the number of vortex rings created is an exponential function of time as predicted by Donnelly and Roberts. However, the velocity dependence of measured nucleation probabilities is only in qualitative agreement with the theory. (auth)

14018 DAMPING OF RIPPLONS IN SUPERFLUID He^4 AT T ≃ 0. Saam, W.F. (Department of Physics, The Ohio State University, Columbus, Ohio 43210). Phys. Rev. A 8: No. 4, 1918-1920 (Oct 1973).

The damping coefficient (imaginary part of the frequency) for ripplons in superfluid He^4 at zero temperature is found to be $\Gamma_q = 0.162\ \hbar q^5/\rho_0$ owing to a process where one ripplon decays into two. (auth)

14019 ACOUSTIC RESONANCE EFFECTS IN THE RICHARDS-ANDERSON EXPERIMENT ON THE JOSEPHSON EFFECT IN SUPERFLUID HELIUM. Rudnick, I. (University of California, Los Angeles, California 90024). Phys. Rev. A 8: No. 4, 1969-1972 (Oct 1973).

It is shown that first- and second-sound resonance can lead to the appearance of spurious stable states and pumping phenomena in the Richards–Anderson experiment on the Josephson effect in superfluid helium, and proposals are made for their elimination. (auth)

14020 HYDRODYNAMICS OF SUPERFLUID HELIUM BELOW 0.6 °K. I. VISCOSITY OF THE NORMAL FLUID. Maris, H.J. (School of Mathematics and Physics, University of East Anglia, Norwich, England). Phys. Rev. A 8: No. 4, 1980-1987 (Oct 1973).

The normal-fluid viscosity of superfluid He^4 has been calculated for temperatures below about 0.6 °K. The calculation assumes that the dominant scattering mechanism is the three-phonon process in the first order of perturbation theory. This contrasts with the previous calculation of Landau and Khalatnikov, who assumed a second-order process involving four phonons. The theory is compared with the experiments of Whitworth on heat flow through tubes. Good agreement is obtained, as regards both the magnitude of the viscosity and its temperature dependence. (auth)

14021 BOSE CONDENSATION AND MOMENTUM DISTRIBUTION IN A SIMPLIFIED LIQUID-^{4}He GROUND STATE. Girardeau, M.D.; Yoon, S.Y. (Institute of Theoretical Science and Department of Physics, University of Oregon, Eugene, Oregon 97403). Phys. Rev. A 8: No. 4, 2009-2016 (Oct 1973).

Bose–Einstein condensation and the atomic momentum distribution are investigated for a simplified liquid ^{4}He ground state obtained by antisymmetrization, with respect to the electron variables, of a product of ^{4}He-atom wave functions, each in its individual electronic and translational ground state. The momentum distribution is defined and evaluated by the method of redundant modes and generalized Tani transformation. Bose–Einstein condensation is found, with a condensate depletion of 6% owing to the purely kinematical repulsion arising from the Pauli exclusion principle. The noncondensed atoms are spread in momentum space by an amount of a few inverse Bohr radii. Dynamical correlations would increase the depletion in a more realistic ground state. (auth)

14022 INTRODUCTION TO THE RENORMALIZATION GROUP. Ma*, S. (Department of Physics and Institute for Pure and Applied Physical Sciences, University of California at San Diego, La Jolla, California 92037). Rev. Mod. Phys. 45: No. 4, 589-614 (Oct

The basic idea of the renormalization group is introduced and illustrative examples are presented. Emphasis is put on the application to the theory of critical phenomena. This article is prepared for pedagogical purposes. It is written at a level that a second-year graduate student in physical sciences can understand. No previous knowledge of critical phenomena or field theory is needed. We make no attempt to survey the field or cover a wide range of subjects. On the contrary, we limit the scope to the most basic aspects. We choose to elaborate at length to make the basic idea clear and the definitions precise, and to go through the examples very carefully. We feel that once these basic aspect are understood, there will be no difficulty in confronting the rapidly expanding literature on this subject. (auth)

14023 SURFACE TENSION ANOMALY AT THE SUPERFLUID TRANSITION. Hohenberg, P. C. (Bell Telephone Labs., Inc., Murray Hill, NJ). J. Low Temp. Phys.; 13: No. 5/6, 433-436 (Dec 1973).

A simple scaling argument is given to estimate the anomaly in surface tension at the λ-point of liquid helium. The result agrees with an earlier one of Sobyanin, based on the Ginzburg–Pitaevskii equation. (auth)

14024 SURFACE TENSION OF THE He II NEAR THE LAMBDA POINT. Gasparini, F. M.; Eckardt, J.; Edwards, D. O.; Shen, S. Y. (Ohio State Univ., Columbus). J. Low Temp. Phys.; 13: No. 5/6, 437-443(Dec 1973).

Measurements of the surface tension of superfluid helium in the neighborhood of the λ-transition are presented. The data are analyzed to obtain the behavior of the "singular" part of the surface tension, which is discussed in the light of the calculation by Sobyanin, based on the Ginzburg–Pitaevskii phenomenological theory, and the results from scaling theory as obtained by Hohenberg. It is found that the behavior of the surface tension suggests a divergent and negative specific heat above and below T_λ and that the free surface correlation length is given by $\zeta = (1.5 \pm 0.4)\mathring{A}|\epsilon|^{-\frac{2}{3}}$, in good agreement with the coherence length in the Mamaladze version of the phenomenological theory. (auth)

14025 LOW TEMPERATURE VISCOSITY OF NORMAL LIQUID ^{3}He. Lawson, D. T.; Gully, W. J.; Goldstein, S.; Reppy,

J. D.; Lee, D. M.; Richardson, R. C. (Cornell Univ., Ithaca, NY) J. Low Temp. Phys.; 13: No. 5/6, 503-523(Dec 1973).

Measurements between 35 and 110 mK along the melting curve indicate that in the normal Fermi liquid region the viscosity of ^{3}He is given by $(\eta T^2)^{-1} = a - bT^n$ with n = 1.0. The measured constants are a = 0.816 and b = 4.43 for n in micropoise and T in Kelvin. Very little solid could be formed in this particular apparatus without immobilizing the vibrating wire viscometer. Patterns were observed in the solidification, however, which suggest that such a device could be operated at much lower temperatures in a compressional cooling cell of appropriate design. A systematic study was made of the excitation of different vibrational modes of the viscometer by varying the magnetic field orientation and the nature of the driving current. The use of tone burst and dc, as well as CW, excitation currents allows the same viscometer to be used over a wide range of viscosities. (auth)

14026 HARD-SPHERE MODEL OF THE HELIUM FILM. Liu, K. S. (New York Univ., NY); Kalos, M. H.; Chester, G. V. J. Low Temp. Phys.; 13: No. 3/4, 227-240(Nov 1973).

A quantum hard-sphere system bounded by two parallel rigid walls is studied at absolute zero as a model of a helium film. A variational wave function is constructed which is of the Bijl–Dingle–Jastrow type modified by a one-body term which vanishes at the walls; Monte Carlo quadrature is used. Attention is focused particularly on the behavior of the single-particle density function and the condensed-state wave function, i.e., the order parameter. Both show significantly different behavior from that predicted by the Hartree theory. The healing length is calculated, it is believed for the first time, and is rather small. The average condensate as a function of distance between two walls is also investigated. The calculation serves as a special probe for approximations to the ground-state wave function in a uniform system. (auth)

14027 LOW-TEMPERATURE HEAT CAPACITY OF HELIUM FILMS ADSORBED ON COPPER. Hickernell, D. C.; McLean, E. O.; Vilches, O. E. (Univ. of Washington, Seattle). J. Low Temp. Phys.; 13: No. 3/4, 241-248(Nov 1973).

Heat capacity measurements are described for films of pure ^{4}He and a 12% ^{3}He mixture of ^{3}He and ^{4}He adsorbed on copper, for $0.1 < T < 1.2$K. ^{4}He heat capacity isotherms show a step-type behavior as a function of coverage for the first two layers, while the mixture isotherms only show the first step. A comparison is made with recent multilayer data for helium films on Vycor published by other authors. (auth)

14028 EXPERIMENTAL STATUS OF THE AC JOSEPHSON EFFECT IN LIQUID HELIUM. Musinski, D. L. (Univ. of Rochester, NY). J. Low Temp. Phys.; 13: No. 3/4, 287-311 (Nov 1973).

The presence of an zc sound field causes several distinct effects in a system of two baths of superfluid liquid helium which are coupled by a small orifice. The primary effects of the sound field can be classified as a "Z–ΔT structure," "steps," and "anomalies." Each of these three effects has been subjected to various criteria which are necessary for an interpretation in terms of the ac Josephson effect. These three effects failed the criteria which were applied, and therefore they are not due to the Josephson effect. However, it is shown that the properties of these three effects correlate quite well with the expected properties of first-sound resonances within one of the two liquid baths. (auth)

14029 SCATTERING OF LIGHT BY THERMAL RIPPLONS ON SUPERFLUID HELIUM. Wagner, F. (Technische Univ., Munich). J. Low Temp. Phys.; 13: No. 3/4, 317-330(Nov 1973).

It is well known that thermally excited waves on the free surface of a liquid can cause light to be diffusely scattered. In order to investigate the possible effects of the superfluid transition in liquid helium, the intensity of the surface scattering from the free surface of liquid helium was measured as a function of temperature (1.3 to 2.1 K) and as a function of the scattering angle. The surface was illuminated vertically from above with a He–Ne laser. A measuring technique was devised which could not only distinguish among background scattering, scattering from the bulk liquid, and scattering from the surface, but could determine the ratio of surface to bulk scattering also. It was found that the results can be described by the theory of Mandelshtam, which is valid for classical liquids. According to this theory, the surface-scattered intensity is given by the ratio of temperature to surface tension. The angular dependence is determined by the characteristic wave vector dependence of the mean square amplitude of the fluctuations. The ratio between surface- and bulk-scattered intensity is calculated on the basis of the classical theory. The data indicate that in the frequency range around about 1 MHz no influence of the two-fluid nature of the superfluid is detectable. (auth)

14030 FOURIER TRANSFORM OF THE MORSE-V_{DD} POTENTIAL. Smith, V. H. Jr.; Thakkar, A. J. (Queen's Univ., Kingston, Ont.). J. Low Temp. Phys.; 13: No. 3/4, 331-335(Nov 1973).

The Fourier transform $\phi(k)$ of the Morse-V_{DD} potential is derived analytically. An expansion of $\phi(k)$ valid for small k is given and comments are made about the occurrence of both even and odd powers of k in the expansion. (auth)

14031 FLUCTUATIONS NEAR THE λ TRANSITION IN ^{4}He. Revzen, M.; Trainor, L. E. H. (Univ. of Toronto). Can. J. Phys.; 51: No. 5, 559-563(1 Mar 1973).

The Guyon–Maki model of the λ transition in liquid ^{4}He is reconsidered with the inclusion of quantum fluctuations. The quantum fluctations remove spurious divergences whilst retaining such successful features of the model as the logarithmic divergence of the specific heat. In addition, an explicit formula is obtained for the thermodynamic potential due to fluctuations near T_λ. (auth)

Superconductivity

Refer also to abstracts 13102, 13193, 13211, 13235, and 14101.

14032 (CALT-822-56) CRITICAL CURRENT DENSITY OF A SUPERCONDUCTING COPPER-BASE ALLOY CONTAINING Nb_3Sn FILAMENTS. Tsuei, C. C.; Suenaga, M.; Sampson, W. B. (California Inst. of Tech., Pasadena (USA). W. M. Keck Lab. of Engineering Materials). Dec 1973. Contract AT(04-3)-822. 12p. Dep. NTIS $3.00.

The critical current density J_c of 0.25 mm $Cu_{88.5}Nb_{10.8}Sn_{1.5}$ wires has been measured at 4.2°K as a function of magnetic field (H) up to 100 kG. A typical value of J_c at H = 0 is $\sim 5 \times 10^4$ A/cm^2 indicating that the critical current density of the Nb_3Sn filaments is probably higher than 5×10^5 A/cm^2. Mechanical deformation of the wires seems to increase J_c. The uniformity of J_c along the wire could probably be improved by increasing the Nb and Sn concentrations. (auth)

14033 (COO-2314-2) EXPERIMENTAL DETERMINATION OF THE TEMPERATURE DEPENDENCE OF METALLIC WORK FUNCTIONS AT LOW TEMPERATURES. Progress Report, March 1, 1973–February 28, 1974. Pipes, P. B. (Dartmouth Coll., Hanover, N. H. (USA). Dept. of Physics and Astronomy). 1974. Contract AT(11-1)-2314. 10p. Dep. NTIS $3.00.

The progress made under AEC Contract No. AT(11-1)-2314 in three areas is briefly reviewed. I) A noise thermometry calibration facility has been completed and is described in technical report no. COO-2314-1. II) The apparatus for applying the modified Kelvin technique to the measurement of the temperature dependence of metallic work functions is nearing completion. A helium temperature preamplifier has been constructed and tested for inclusion in this apparatus. III) Investigation of the effects of thermal gradients on critical currents in superconducting microbridges has been started to provide information complementary to the work function measurements. (auth)

14034 SCREENING-APPROXIMATION PREDICTION OF PEAKING IN THE SPECIFIC HEAT OF A SUPERCONDUCTING FILM. Scalapino, D.J. (Department of Physics, University of California, Santa Barbara, California, 93105); Ferrell, R.A.; Bray, A.J. Phys. Rev. Lett. 31: No. 5, 292-295 (30 July 1973).

All contributions to the free energy of O(n) and of O(1) are computed for an n-component two-dimensional Ginzburg–Landau field. The O(1) terms correspond to ring diagrams, and their sum constitutes the first-order screening approximation. The second derivative of the free energy with respect to temperature yields a predicted specific heat for n=2 which peaks, in qualitative disagreement with the monotonic temperature variation found experimentally for superconducting film by Zally and Mochel. (auth)

14035 LOW-TEMPERATURE PROPERTIES OF LAYERED TRANSITION METAL DICHALCOGENIDE COMPOUNDS. Schwall, R. E. Stanford, CA; Stanford Univ. (1973). 141p. University Microfilms Order No. 73-30,473.

Thesis (Ph. D.).

Properties of the superconducting state in certain layered transition metal dichalcogenides are described. The dimensionality of the superconducting order parameter and the influence of intercalated organic molecules on superconductivity are considered. Measurements of the fluctuation diamagnetism in intercalated materials are presented. Measurements made in the limit of zero magnetic field are compared with high-field measurements and with measurements on three-dimensional alloys. Results are interpreted within the framework of the Ginzburg–Landau theory. Measurements of the pressure dependence of the

superconducting transition temperature were made on a variety of materials using pressures up to 25 kilobars. Measurements of the low-temperature specific heat are presented including measurements in magnetic fields up to 12 kilogauss. The system developed to make these measurements on very small single-crystal samples is described. The system uses a small computer to control the experiment and provide real-time data analysis. Observed properties are discussed in terms of the McMillan theory of strong-coupling superconductors and in terms of the anisotropic Ginzburg–Landau theory. The unintercalated materials can be adequately described as highly anisotropic, strongly coupled, type-II Superconductors. (Diss. Abstr. Int.,B)

14036 CRITICAL CURRENT DENSITY IN SUPERCONDUCTING VANADIUM WITH PINNING CENTERS INDUCED BY NEUTRON IRRADIATION. Tsubakihara, H.; Okada, T.; Suita, T. (Osaka Univ.). Phys. Status Solidi (a); 20: No. 2, K103-K107 (16 Dec 1973).

The critical current density J_c of V single crystals before and after irradiation is described in terms of the reduced temperature t and external magnetic field H. The plot of J_c vs $H^{-\frac{1}{2}}$ show three stages in the slope; J_c in the second stage is analyzed using the flux line lattice dislocation motion. Equations are derived for the driving and pinning forces on the dislocations, and the interactions involved are discussed. Neutron irradiation causes an increase in the pinning force. (DLC)

14037 NEW SUPERCONDUCTING STATE. Fink, H. J. (Univ. of California, Davis). Phys. Status Solidi (b); 60: No. 2, 843-853 (1 Dec 1973).

In long one-dimensional superconductors, such as whiskers and thin wires, new current-carrying states above the critical current were found that are due to spatially periodic solutions of the modulus of the order parameter and spatially periodic super and normal transport currents in parallel. The order parameter is zero at certain points in the whisker, thereby permitting the phase of the order parameter to slip in time of one singly-connected superconducting region with respect to the adjacent, the consequence of which is a dc potential difference between the separate singly-connected superconducting regions. In this model, the modulus of the order parameter is time-independent, the phase is time-dependent, and the difference of the pair electrochemical potentials between adjacent singly connected superconducting regions is an integer fraction of the total voltage difference across the whisker. These solutions lead to voltage steps in the dc voltage–current characteristic of thin whiskers. The upper critical current is derived at which the superconductor becomes completely normal conducting. This current is much larger than the current at which the first voltage step occurs. Agreement with experiments is good. (auth)

14038 NEW TYPE OF DOMAIN STRUCTURE IN THE SUPERCONDUCTING INTERMEDIATE STATE. Farrell, D. E. (Case Western Reserve Univ., Cleveland); Huebener, R. P.; Kampwirth, R. T. Phys. Status Solidi (a); 20: No. 2, 419-428(16 Dec 1973).

A new size-limited type of intermediate state structure consisting of just a single superconducting domain was investigated. The structure exhibits simple behavior, certain aspects of which can be understood within the framework of the Landau theory. A slight change in magnetic field configuration transforms the single domain into essentially two, and these manifest all the complex path-dependent features normally associated with the intermediate state. 9 figures. (auth)

14039 SUPERCONDUCTIVITY AND STRUCTURE OF SOME TERNARY MOLYBDENUM SULFIDES. Morton, N.; Booth, J. G.; Woodhead, C. F. (Univ. of Salford, Eng.). J. Less-Common Metals; 34: 125-130(1974).

Ternary molybdenum sulfides containing copper, tin, or lead were prepared, and the crystal structures were investigated by x-ray diffraction methods. The superconducting critical temperatures were measured and are slightly higher than those previously found for these compounds. The normal state susceptibilities were measured, and the magnitudes are rather low, indicating that moderate densities of electronic states exist at the Fermi levels, in contrast with the very high values reported by previous investigators. The upper critical fields of the ternary sulfides are probably very high, and evidence is presented for the existence of a superlattice structure in the compounds containing tin or lead. (auth)

14040 ULTRASONIC INVESTIGATION OF THE SUPERCONDUCTING SURFACE SHEATH. Kraetzig, E. (Philips Forschungslaboratorium, Hamburg). Phys. Status Solidi (b); 60: No. 2, K79-K81(1 Dec 1973).

The ultrasonic attenuation (250 MHz) of thick Pb–0.3% and 2% Bi films on quartz crystals was determined as a function of magnetic field. Results are compared with calculated numbers of Cooper pairs in the surface sheath. Coherence and G–L parameters are determined. (DLC)

14041 ELECTROMAGNETIC SURFACE RESISTANCE OF A SUPERCONDUCTING ALUMINUM ALLOY. Ginsberg, D.M. (Department of Physics and Materials Research Laboratory, University of Illinois, Urbana, Illinois 61801). Phys. Rev. B 8: No. 5, 2358-2359 (1 Sept 1973).

A definitive test of the theory of high-frequency electromagnetic absorption in bulk superconductors is made possible by the recent publication of data for an aluminum alloy. The theoretical values have been calculated. The agreement between theory and experiment is good. (auth)

14042 ADDENDUM TO THE FLUX-FLOW THEORY FOR PURE TRANSITION-METAL SUPERCONDUCTORS NEAR H_{c2}. Tang, I. (Department of Physics, American University of Beirut, Beirut, Lebanon). Phys. Rev. B 8: No. 5, 2369-2373 (1 Sept 1973).

Using the two-band transport equations previously derived by the author for pure transition-metal superconductors in the flux-flow states near H_{c2}, expressions for the Ettingshausen and Peltier effects, which take into account the presence of a second band and a second energy gap in the transition-metal superconductors, are obtained. The two-band expressions are used to explain the difference in the slope of the measured transport coefficients in two pure-niobium superconductors (one with a residual resistance ratio of 6500 and the other with 130), which cannot be accounted for by the flux-flow theory developed by Maki for a one-band superconductor. (auth)

14043 FAR-INFRARED MEASUREMENT OF THE ENERGY GAP OF V_3Si. Tanner, D.B.; Sievers, A.J. (Laboratory of Atomic and Solid State Physics, Cornell University, Ithaca, New York 14850). Phys. Rev. B 8: No. 5, 1978-1981 (1 Sept 1973).

We have measured in the far infrared (2–70 cm^{-1}) the difference between the surface impedances of normal and superconducting V_3Si at various temperatures. The radiation was transmitted through a nonresonant cavity containing several single crystal slabs of V_3Si using a lamellar grating interferometer in conjunction with a ^3He-cooled bolometer detector. A vacuum window isolated the detector from the nonresonant cavity. Temperature-dependence measurements have been made up to 30 °K and no change in the surface impedance was observed near the martensitic phase transition at 21 °K. There was a spread in the valve of the energy gap, extending, at 4.2 °K, from 12 cm^{-1} ($2\Delta_{min} = 1.0kT_c$) to 46 cm^{-1} ($2\Delta_{max} = 3.8kT_c$). (auth)

14044 PRESSURE DEPENDENCE OF ELASTIC CONSTANTS AND OF SUPERCONDUCTIVITY FOR V_3Ge. Carcia, P.F.; Barsch, G.R. (Materials Research Laboratory and Department of Physics, The Pennsylvania State University, University Park, Pennsylvania 16802). Phys. Rev. B 8: No. 6, 2505-2515 (15 Sept 1973).

The pressure dependence of the single-crystal elastic constants of V_3Ge was measured ultrasonically by the pulse-superposition method as a function of temperature from 10.5 to 298 °K. The pressure derivatives of c_{11} and of $c_s = (c_{11}-c_{12})/2$ are strongly temperature dependent. They become negative and show minima at low temperature. The low- and high-temperature limits of the Grüneisen parameters, γ_0 and γ_∞, calculated in the anisotropic-elastic-continuum approximation are compatible with the available data for the thermal Grüneisen parameter. The pressure coefficient of the superconducting transition temperature calculated from the elastic data has the proper sign and order of magnitude as, but is smaller than, the experimental value. (auth)

14045 SUPERCONDUCTIVITY IN Nb-Ge FILMS ABOVE 22 K. Gavaler, J.R. (Westinghouse Research Laboratories, Pittsburgh, Pennsylvania 15235). Appl. Phys. Lett. 23: No. 8, 480-482 (15 Oct 1973).

Niobium-germanium films which remain superconducting up to 22.3 K have been prepared by a high-pressure dc sputtering process. The high T_c's of these films are attributed to the formation of a more nearly perfect stoichiometric Nb_3Ge compound than has previously been obtainable. (auth)

14046 COEXISTENCE OF FLUX-SPOT AND LAMINAR INTERMEDIATE STATE IN SUPERCONDUCTING THIN FOILS. Bodmer, A. (Institut fuer Physik, Stuttgart). Phys. Status Solidi (a); 19: No. 2, 513-518(16 Oct 1973).

Flux-spot and laminar structures established after $(SI)_T$-transitions in thin superconducting lead foils in perpendicular magnetic fields were investigated by decorating the flux carrying domains. The surface energies of the S–N interfaces of both structures were evaluated using existing models. The laminar domains are aligned along the projections of the ⟨111⟩ directions on the planes of the monocrystalline foils. (auth)

14047 DYNAMIC PHASE STRATIFICATION AND GENERATION OF ELECTROMAGNETIC WAVES IN THIN CURRENT-CARRYING SUPERCONDUCTING FILMS. Galaiko, V. I.; Dmitriev, V. M.; Churilov, G. E. (Physical-Technical Inst. of Low

Temperatures, Kharkov). JETP Lett. (USSR) (Engl. Transl.); 18: No. 6, 213-215(20 Sep 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 6, 362-365(20 Sep 1973).

The current–voltage characteristics (CVC) of thin films were investigated. They were connected in a resonant circuit tunable from 30 to 230 MHz and the CVC and the amplitude and frequencies of the generated oscillations had forms similar to those in Churilov, et al, [JETP Lett. 10, 146 (1969)]. No hysteresis was observed on the CVC at the point corresponding to generation at a given frequency. The agreement between the experimental temperature dependence of the critical current with the Ginzburg–Landau theory was checked for the investigated films. (MHR)

14048 LANDAU THEORY OF THE PEIERLS-BCS TRANSITION. Gunther, L. (Tufts Univ., Medford, MA). Phys. Lett.; 45A: No. 5, 367-368(22 Oct 1973).

A Landau type theory of the Peierls instability-superconductor transition involving two complex order parameters is introduced. Under a particular inequality condition among expansion parameters, the theory predicts that the superfluid conductivity should vary as $(T-T_c)^{-\frac{1}{2}}$ above the critical region and as $(T_c^*-T)^{-\frac{1}{2}}$ below the critical region. (auth)

14049 FLUCTUATIONS IN THE ELECTRICAL CONDUCTIVITY OF QUENCH-CONDENSED Nb FILMS. Kawaguti, T.; Shibuya, Y. (Kyushu Univ., Fukuoka). Phys. Lett.; 45A: No. 5, 395-396(22 Oct 1973).

Resistive transitions of niobium films evaporated onto the substrate at cryogenic temperatures have been investigated. The Maki–Thompson term gives a contribution to the excess electrical conductivity of highly disordered Nb film. (auth)

14050 LATTICE INSTABILITY AND HIGH SUPERCONDUCTING TRANSITION TEMPERATURE. Ramakrishnan, T. V. (Indian Inst. of Tech., Kanpur). J. Phys., C. (London); 6: No. 21, 3141-3146(30 Oct 1973).

The high T_c and lattice instability of some A_3B compounds (e.g., V_3Si, Nb_3Sn) have been considered as resulting from fine structure in the bare density of states (Labbé et al.; Phys. Rev. Lett.; 19: 1039 (1967)). Here an alternative explanation is presented which directly connects their high T_c with the shear mode lattice instability. The electronic structure of the A_3B's is such that there is a significant umklapp coupling of electrons near the Fermi surface to low q TA phonons. This leads to enhanced phonon induced e–e attraction as the TA mode goes soft. Estimates show that for reasonable values of the parameters concerned the observed rise can be obtained, say from $T_c(V_3Ge) = 6$ K to $T_c(V_3Si) = 17$ K as the TA mode goes completely soft. With the same parameters, good agreement is obtained with the observed pressure dependence of T_c in V_3Ge and the variation of T_c in the system $V_3Ge_xSi_{1-x}(0 \leq x \leq 1)$. It is suggested that similar physical conditions are present in some alloys which show a high T_c near a phase transformation boundary. (auth)

14051 LANDAU THEORY OF THE PEIERLS–BCS TRANSITION. Gunther, L. (Tufts Univ., Medford, MA). Phys. Lett.; 45A: No. 5, 367-368(22 Oct 1973).

A Landau type theory of the Peierls instability-superconductor transition involving two complex order parameters is introduced. Under a particular inequality condition among expansion parameters, the theory predicts that the superfluid conductivity should vary as $(T-T_c)^{-\frac{1}{2}}$ above the critical region and as $(T_c^*-T)^{-\frac{1}{2}}$ below the critical region. (auth)

14052 ULTRASONIC ATTENUATION BY ELECTRONS IN ALUMINUM. Simpson, A. M.; Pazionis, G. O. (Dalhousie Univ., Halifax, Nova Scotia). J. Phys., F (London); 3: No. 11, 1933-1940 (Nov 1973).

The change in the attenuation coefficient of ultrasonic shear waves in aluminum between the normal and the superconducting states has been measured and compared with the change between zero field and high magnetic field applied parallel to the propagation direction. Contrary to some predictions, these values are not the same. The change in high field is less than that over the superconducting transition, indicating the persistence of a mechanism for electron–phonon interaction up to the highest fields obtained (5 T). Possible sources of this interaction are discussed. (auth)

14053 SPECIFIC HEAT JUMP OF SUPERCONDUCTING $La_{1-x}Tb_xAl_2$ RELATED TO CRYSTAL ELECTRIC FIELD SPLITTING OF THE Tb^{3+} LEVELS. Happel, H.; Hoenig, H. E. (Univ., Frankfurt am Main). Solid State Commun.; 13: No. 10, 1641-1643 (15 Nov 1973).

Measurements of the specific heat jump $\Delta c(T_c)$ were performed on superconducting $La_{1-x}Tb_xAl_2$ compounds in order to investigate the pairbreaking effect of Tb^{3+} ions in the $LaAl_2$ host. The results deviate from the Abrikosov-Gorkov theory for superconductors with magnetic impurities. Taking into account the crystal field level structure of Tb^{3+} in $LaAl_2$ the results can be qualitatively understood within the model of Fulde, Keller and Peschel. According to calculations published by Mueller–Hartmann and Zittartz an influence of the Kondo effect can be ruled out. (auth)

14054 PRESSURE DEPENDENCE OF SUPERCONDUCTING ENERGY GAPS FROM HIGH-PRESSURE CRITICAL FIELD MEASUREMENTS. Rothwarf, F.; Dubeck, L. W. (Army Electronic Labs., Fort Monmouth, NJ). Solid State Commun.; 13: No. 10, 1645-1649(15 Nov 1973).

It is shown that the Toxen relationship $\Delta/kT_c = T_c/H_c(0)\ (dH_c/dT)_{T_c}$ can be used to obtain Δ/kT_c as a function of pressure from critical field curves taken at high pressures. Data for Sn, In, Zn, Al, Cd, Ga, and Th are analyzed and $\Delta\ (p)kT_c$ are tabulated. For Sn and In a comparison was made of energy gaps so determined with those measured directly by tunnelling. (auth)

14055 PHONON SPECTRAL FUNCTION OF A SUPERCONDUCTOR. Schuster, H. G. (Brookhaven National Lab., Upton, NY). Solid State Commun.; 13: No. 10, 1559-1562(15 Nov 1973).

The phonon spectral function of an acoustic phonon in a BCS superconductor is calculated at zero temperature and compared to the result for the normal metal. Shifts are found in the frequency and linewidth of the phonon depending on its wavevector. In addition to the phonon, the spectral function shows a structure around the gap energy of the superconductor, reflecting the increased polarizability of the superconducting electrons at this energy. (auth)

14056 EXPERIMENTS ON THE ANISOTROPY IN THE SURFACE RESISTANCE OF SUPERCONDUCTORS IN THE REGION H_{c3}. Bodin, C.; Baixeras, J. (CEN, Fontenay-aux-Roses, France). Solid State Commun.; 13: No. 10, 1545-1548(15 Nov 1973). (In French).

Some experimental results are presented on the anisotropy of the surface resistance near H_{c3} of some alloys for which the values of κ (the Ginzburg–Landau parameter) are between 1.2 and 4.6. The results seem to indicate that present theories are incomplete, due to the fact that the influence of the κ parameter is not sufficiently taken into account. (auth)

14057 OBSERVATIONS ASSOCIATED WITH NON-LINEAR VOLTAGE–CURRENT CHARACTERISTICS OF TYPE II SUPERCONDUCTORS. Ekin, J. W.; Laimins, L. A.; Serin, B. (Rutgers–The State Univ., New Brunswick, NJ). Solid State Commun.; 13: No. 10, 1681-1683(15 Nov 1973).

Independent currents at right angles were sent through type-II superconducting aluminium films in the flux-flow state, and the voltage measured along one of the current directions. The voltage was found to increase with increasing perpendicular current, due to the nonlinear voltage characteristics of the specimens. (auth)

14058 VORTEX FLOW IN GRANULAR ALUMINUM FILMS. Ogushi, T.; Rinderer, L. (Univ., Lausanne, Switzerland). J. Low Temp. Phys.; 13: No. 3/4, 349-363(Nov 1973).

The vortex flow and the resistive transition of granular Al films have been measured as a function of the magnetic field perpendicular to the film surface. The effects of fluctuations of the superconducting order parameter on the vortex flow resistance R_f are discussed and compared with the theory of Maki and Takayama. The depression of R_f below H_{c2} has been observed together with an electric field dependence of R_f. The depression of R_f is shown to agree qualitatively with the theoretical prediction. The field dependence of R_f appears to be related to that of the excess conductivity above H_{c2}. (auth)

14059 EFFECTIVENESS OF THE EXCITON MECHANISM IN SUPERCONDUCTING LAYERED COMPOUNDS. Little, W. A. (Stanford Univ., CA). J. Low Temp. Phys.; 13: No. 3/4, 365-369 (Nov 1973).

The excitonic interaction resulting from an array of adsorbed dyes on a plane conducting metallic sheet is considered. It is shown that only with the appropriate choice of dye and with certain constraints on the structure and properties of the metallic system can this interaction be strong enough to influence the superconducting properties of the sheet. (auth)

14060 INFLUENCE OF PROTON IRRADIATION ON THE CRITICAL CURRENT DENSITY $J_c(B,T)$ OF NbTi. Wohlleben, K. (Siemens Research Labs., Erlangen, Ger.). J. Low Temp. Phys.; 13: No. 3/4, 269-286(Nov 1973).

The critical current density j_c of a copper-coated single-core wire of Nb–50 wt.% Ti has been measured as a function of the magnetic flux density ($1 \leq B \leq 8T$) and the temperature ($2.5\ K \leq T \leq T_c$). Irradiation with 3.1-MeV protons at 25 K up to a flux of $1 \times 10^{17}\ cm^{-2}$ led to a T_c drop of 0.17 K and an almost uniform de-

gradation of 19% over the complete $j_c(B,T)$ surface. After annealing for 1 h at 285 K only 40% of the j_c degradation remained. The $j_c(B,T)$ surface can be described, independent of the irradiation dose, approximately by $j_c(B,T) \sim B_{c2}(T) - B$, giving a pinning force density of $F_p = j_c B \approx 4F_{p,max} b(1-b)$, where $b = B/B_{c2}$ and $F_{p,max} \sim B_{c2}^2$. The defect structure responsible for the vortex pinning is not affected by irradiation. The j_c decrease on irradiation results from approximately 70% from a decrease of $F_{p,max}$ and 30% from the T_c decrease. (auth)

14061 KONDO EFFECT IN SUPERCONDUCTORS: THE MAGNETIC SUSCEPTIBILITY. Crisan, M. (Univ., Cluj). J. Low Temp. Phys.; 13: No. 3/4, 261-267(Nov 1973).

The vertex-part integral equation is adopted for the study of the Kondo problem in superconductors. The bound-states obtained are in good agreement with other results, but two critical values were obtained for the bound states as a consequence of the two signs for J (the s-d interaction). The temperature dependence of the magnetic susceptibility has been calculated using the result for the vertex function Γ. (auth)

14062 PHASE TRANSITION OF AN ITINERANT-ELECTRON ANTIFERROMAGNET. Fenton, E. W. (National Research Council of Canada, Ottawa). J. Low Temp. Phys.; 13: No. 5/6, 525-551(Dec 1973).

A weak-coupling theory of the itinerant-electron antiferromagnet for $T > T_c$ is described. Vertex and self-energy parts are treated self-consistently using Ward-Pitaevskii identities. The weak-coupling criterion is that the scalar three-vertex must be suitably small. This condition is not satisfied right down to T_c; however, it is satisfied in a region near T_c where the corrections to the bare electron-electron interaction are not small. Expressions are derived for the specific heat, temperature derivative of the electrical resistivity, etc., which are all proportional to the weakly singular form $[T_c/(T-T_c)]^h$, with $h \ll 1$. An analogous theory applies for superconductors. In this case the weak-coupling exponent h is approximately equal to $(T_c/E_F)^2$. This quantity is typically 10^{-6}-10^{-7} for superconductors, and in the weak-coupling temperature regime the lambda curve singularity would not be observable experimentally. However, for an itinerant-electron antiferromagnet such as chromium, the quasicubic shape of the electron and hole Fermi surfaces causes enhancement of h to a value of order 10^{-1}. For chromium the theory is consistent with experimental results and with a recent theory by Dzyaloshinskii and Kats (using a different method). (auth)

14063 THERMODYNAMIC PROPERTIES OF SUPERCONDUCTING IRIDIUM. Gubser, D. U.; Soulen, R. J. Jr. (Naval Research Lab., Washington, DC). J. Low Temp. Phys.; 13: No. 3/4, 211-226(Nov 1973).

The superconducting transition temperature of pure Ir is found to be 0.1125 K (± 0.0005 K). The critical magnetic field as a function of temperature $H_c(T)$ has also been measured. From these data it is determined that $H_c(0)$ is 16.00 G (1 G corresponds to 10^{-4}T), $(dH_c/dT)_{T=T_c}$ is 235 G/K, the linear coefficient of normal state electronic specific heat γ is 3.19 mJ/mole-K^2, and the energy gap anisotropy parameter $\langle a^2 \rangle$ is 0.048. This value for $\langle a^2 \rangle$ is the largest of any superconducting element so far observed, and its significance in determining the superconducting properties of Ir is discussed. By using the large supercooling effects noticed near T_c, the Ginzburg-Landau parameter κ_0 is found to be 8.6×10^{-2}. The effects of impurities on T_c and on the magnetic behavior of Ir are also discussed. (auth)

14064 STATISTICAL TREATMENT OF OPEN SYSTEMS BY GENERALIZED MASTER EQUATIONS. Haake, F. (Univ., Stuttgart). Springer Tracts Mod. Phys.; 66: 98-168(1973).

The dynamics of open systems (S) moving irreversibly under the influence of their surroundings (B) are discussed. As a basis for the discussion of an open system, a complete microscopic description of the composite S ⊕ B. By eliminating the coordinates of B, the behavior of S is inferred. The motivation for this investigation is that nature frequently confronts us with coupled systems S and B only one of which, say S, is of experimental relevance. It is then a dictate of economy to look for a "closed" description of the dynamics of S alone. The physical systems treated in some detail here are the damped harmonic oscillator, superconductors, superradiant devices, the laser, and the Heisenberg magnet near the Curie temperature. (MHR)

14065 LONDON MOMENT IN ROTATING SUPERCONDUCTING CYLINDERS. Rystephanick, R. G. (Univ. of Saskatchewan, Regina). Can. J. Phys.; 51: No. 8, 789-794(15 Apr 1973).

A microscopic treatment, based on the BCS model of a superconductor, of the magnetic field generated inside a rotating cylindrical superconductor (London moment) is presented. The rotation of the superconductor is treated by considering the superconductor to be in an appropriate gravitational field and Bogolyubov's self-consistent field method is used to calculate the current generated by the rotation. The field obtained is found to agree with that predicted by other treatments and observed experimentally. (auth)

14066 ELECTRON-PHONON INTERACTION SUPERCONDUCTING Nb. Shirane, G.; Axe, J. D.; Shapiro, S. M. (Brookhaven National Lab., Upton, NY). Solid State Commun.; 13: No. 11, 1893-1895(1 Dec 1973).

Acoustic phonon damping in Nb due to superconductivity is accurately measured by the inelastic neutron scattering technique. The phonon line widths can be characterized by the reduced parameters $\hbar\omega_p/2\Delta(0)$ and T/T_c, and are in good qualitative agreement with the calculation by Bobetic (Phys. Rev.; 126:A 1535 (1964)) based on the BCS theory. (auth)

14067 EFFECT OF PRESSURE ON THE CRYSTALLINE ELECTRIC FIELD LEVELS OF SUPERCONDUCTING $La_{1-x}Tb_xAl_2$. Guertin, R. P. (Tufts Univ., Medford, MA); Boivin, W.; Crow, J. E.; Sweedler, A. R.; Maple, M. B. Solid State Commun.; 13: No. 11, 1889-1891(1 Dec 1973).

The pressure dependence of the superconducting transition temperature (dT_c/dP) is smaller for $La_{1-x}Tb_xAl_2$ than for $LaAl_2$. The difference is attributed to an increase with pressure of the crystalline electric field energies experienced by the Tb ion. (auth)

14068 ANISOTROPIC FLUX-LINE LATTICE IN SUPERCONDUCTING NIOBIUM. Kahn, R.; Parette, G. (CEN de Saclay, Gif-sur-Yvette, France). Solid State Commun.; 13: No. 11, 1839-1843(1 Dec 1973).

A report is presented on a neutron diffraction experiment by the flux-line lattice of a superconducting single crystal of niobium with an applied magnetic field along three different crystallographic axes. In the directions where the gap and Hc_2 are highly anisotropic, the elementary cell is found to be an isosceles triangle, the flux lattice orientation being very well defined relatively to the lattice of the niobium. In the same directions, the measurement of the integrated reflectivity gives Fourier components of the local magnetic field having lost the six-fold symmetry. (auth)

14069 LATTICE TRANSFORMATION IN THE SUPERCONDUCTOR ZrV_2 BY NEUTRON DIFFRACTION. Moncton, D. E. (Massachusetts Inst. of Tech., Cambridge). Solid State Commun.; 13: No. 11, 1779-1782(1 Dec 1973).

The 120 K phase transition in ZrV_2 has been investigated for magnetic and crystallographic effects using neutron diffraction. A cubic-rhombohedral martensitic transformation was observed at 116.7 K. No local magnetic moments, either ordered or disordered, were found to exist between 5.4 K and 300 K. (auth)

14070 LOW TEMPERATURE MAGNETO-RESISTANCE, LOGARITHMIC RESISTIVITY RISE AND ANISOTROPIC SUPERCONDUCTIVITY IN TaS_2(PYRIDINE)1/2. Thompson, A. H. (Esso Research and Engineering Co., Linden, NJ). Solid State Commun.; 13: No. 11, 1911-1913(1 Dec 1973).

The superconducting intercalation complex TaS_2(pyridine)$_{\frac{1}{2}}$ has received considerable attention as a prototype of two-dimensional superconductivity. In this material a substantial, anisotropic magneto-resistance 11°K above the superconducting transition has been detected, and an anisotropic logarithmic resistivity rise below 20°K. The resistively measured superconducting transition temperature is also anisotropic. T_c is the lowest when the current is perpendicular to the layers. (auth)

14071 SELF-DETECTING OF AC JOSEPHSON CURRENTS IN THIN FILM SUPERCONDUCTING BRIDGES. Dmitriev, V. M.; Khristenko, E. V.; Solovev, A. L. (Physical-Technical Inst. of Low Temperatures, Kharkov). Phys. Status Solidi (a); 19: No. 2, K157-K159(16 Oct 1973).

Intrinsic current steps in the I-V characteristics of thin film superconducting bridges were observed using a dielectric rutile resonator as a high-Q resonator. It is shown that the observation of these steps proves the existence of the ac Josephson effect in these bridges. (MHR)

14072 DIRECT OBSERVATION OF SOFT MODE STIFFENING IN V_3Si BY HIGH MAGNETIC FIELDS. Cheeke, J. D. N.; Mallie, H. (CNRS, Grenoble, France). Solid State Commun.; 13: No. 10, 1567-1570(15 Nov 1973).

The velocity of the soft mode associated with the martensitic phase transition in V_3Si has been studied by ultrasonic means in magnetic fields up to 84 kOe for temperatures between 10 and 25 K. Above the superconducting transition temperature the velocity of this mode has been found to increase quadratically with field, in agreement with the lattice stiffening effect predicted by Dieterich and Fulde (Z. Physik; 248: 154 (1971)). (auth)

14073 SIMPLE AND ACCURATE EQUATION FOR THE SUPERCONDUCTING TRANSITION TEMPERATURE. Leavens, C. R. (National Research Council of Canada, Ottawa). Solid State Commun.; 13: No. 10, 1607-1610(15 Nov 1973).

Reasonable and consistent approximations are used to reduce the simplified form of the BCS integral equations for the superconducting transition temperature used by Allender, Bray and Bardeen [Phys. Rev.; B3: 1020 (1973)] to a very simple, and remarkably accurate, equation for T_c. This equation is compared with the McMillan [Phys. Rev.; 167: 331 (1968)] equation and found to give just as good agreement with experiment for intermediate-coupling materials and considerably better agreement for strong-coupling materials. (auth)

14074 DEVELOPMENT OF HARD SUPERCONDUCTORS, ESPECIALLY OF Nb–Ti. Part 2. Hillmann, H. Metall; 27: No. 10, 977-982(1973). (In German).

With the aim of developing superconductors for technical use, aspects are presented for the concept of special types of conductors. In the present second part of the paper the following problems are individually discussed and their technical solutions with examples are explained: aspects for the concept of certain conductor shapes; possibilities as well as marginal conditions for the fixing of conductor measurements; fabrication tolerances and isolation problems; conductors for dynamic requirements: a) aspects for the introduction of a twist, b) conductor with resistance matrix, c) transposed conductor in the form of wires and meshes; and remarks on the technology and state with connecting superconductors. (GE)

14075 PARAMAGNETIC EFFECT OF THE SURFACE MIXED STATE IN TYPE I SUPERCONDUCTORS. Bestgen, V. (Inst. of Physical Problems, Moscow). Zh. Eksp. Teor. Fiz.; 65: No. 5, 2096-2104(Nov 1973). (In Russian).

A two-dimensional "mixed" state is observed at the inner surface of a hollow cylindrical superconductor with a current. The response of the system to a weak longitudinal magnetic field is investigated. The calculation yields a paramagnetic behavior. (auth)

14076 ELECTRIC CONDUCTIVITY AND THE SUPERCONDUCTING PROPERTIES OF THIN MERCURY FILMS. Tsymbalenko, V. L.; Shal'nikov, A. I. (Inst. of Physical Problems, Moscow). Zh. Eksp. Teor. Fiz.; 65: No. 5, 2086-2096(Nov 1973). (In Russian).

A technique is developed for obtaining mercury films at condensation temperatures of 2.3 to 4.2°K under maximally reproducible conditions. The electric conductivity and superconductive properties of cold-deposited mercury films (effective thickness d = 0 to 1000 Å) are investigated. It is found that for a thickness up to 20 atomic layers $R = \rho/d \gg 10^{10}$ ohms; for thicknesses of 20 to 23 atomic layers the films are not superconductive but become so at greater thicknesses. The R(d) and T_c(d) dependences are measured and nonsuperconductive films are investigated in detail. The superconductivity transition curves are compared with the Aslamazov–Larkin theory, $g_{exp}^{AL} = (1.7 \pm 0.3) \cdot 10^{-5}$ ohm^{-1}. Changes in the electric conductivity and superconductivity properties of the films on recrystallization are studied. (auth)

14077 COLLISIONLESS RELAXATION OF THE ENERGY GAP IN SUPERCONDUCTORS. Volkov, A. F.; Kogan, Sh. M. (Inst. of Radio Engineering and Electronics, Moscow). Zh. Eksp. Teor. Fiz.; 65: No. 5, 2038-2046(Nov 1973). (In Russian).

Equations for the Green functions with coinciding times are derived which describe the dynamics of superconductors over a period of time which is small compared with the electron energy relaxation times τ_{ph} and τ_{ee}. The time evolution of small initial perturbations of the order parameter is investigated. It is found that for initial perturbations of a certain type the energy gap relaxes only at the expense of inelastic electron collisions during a time of the order of τ_{ph} or τ_{ee}. In the general case the order parameter, for $t \ll \tau_{ph}, \tau_{ee}$, oscillates with a frequency ~2Δ and an amplitude which asymptotically decays with time according to a power law. (auth)

14078 INFLUENCE OF THE PROXIMITY EFFECT ON THE THERMODYNAMIC AND MAGNETIC PROPERTIES OF MULTILAYER SUPERCONDUCTORS. Galaiko, V. P.; Bezuglyi, E. V. (Physical-Technical Inst. of High Temperatures, Kharkov). Zh. Eksp. Teor. Fiz.; 65: No. 5, 2027-2037(Nov 1973). (In Russian).

Formulas are derived for the critical temperature of a superconducting sample consisting of alternating thin ($d \ll \xi_0$) films of two metals differing in their electron–electron interaction and electron densities. Equations of the Ginzburg–Landau type are obtained for the order parameter under the same conditions. Inhomogeneity of the sample leads to the appearance of effective anisotropy of the superconducting properties and the latter therefore are described by quantities of a tensor nature. (auth)

14079 SURFACE CHARGE OSCILLATIONS IN SUPERCONDUCTORS. Kulik, I. O. (Physical-Technical Inst. of High Temperatures, Kharkov). Zh. Eksp. Teor. Fiz.; 65: No. 5, 2016-2022 (Nov 1973). (In Russian).

The existence of low frequency "plasma" oscillations in superconducting films and thin filaments is predicted which is analogous to the Josephson plasma oscillations in tunnel junctions. An attempt is made to explain them with aid of the recently observed generation of a high frequency field in superconducting films in the resistive state. (auth)

14080 THEORY OF SUPERCONDUCTIVITY IN THE PRESENCE OF ELECTRON-HOLE PAIRING IN SEMI-METALS AT T = 0. Rusinov, A. I.; Do Chan Kat; Kopaev, Yu. V. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz.; 65: No. 5, 1984-1998 (Nov 1973). (In Russian).

The possibility of simultaneous Cooper pairing of electrons within each of the bands (S) and of electron-hole pairing (D) is studied in the isotropic model of a semi-metal with overlapping bands with allowance for Coulomb interaction and structural instability. An equation describing the metastable SD phase at T = 0 is obtained for equal electron and hole concentrations. The influence of S and D pairings on each other is studied for a doped semi-metal. It is shown that under certain conditions D pairing leads to an increase of the critical temperature of the superconductor. The regions of existence of S, D and SD phases are found at T = 0 (in dependence on the ratio of the coupling constants) and the nature of the phase transitions between them is determined. (auth)

14081 EFFECT OF SURFACE AND VOLUME DEFECTS ON DISSIPATIVE PROCESSES IN TYPE II SUPERCONDUCTORS. Chigvinadze, J. G. (Inst. of Physics, Tbilisi, USSR). Zh. Eksp. Teor. Fiz.; 65: No. 5, 1923-1927(Nov 1973). (In Russian).

A mechanical technique for investigating dissipative processes in the mixed state is proposed which is several orders of magnitude more sensitive than the well known electric method. The effect of surface and volume defects on dissipative processes caused by motion of Abrikosov vortices is studied. (auth)

14082 EXPERIMENTAL STUDIES OF THIN SUPERCONDUCTING ALUMINUM FILMS. Holdeman, L. B. Stanford, CA; Stanford Univ. (1973). 124p. University Microfilms Order No. 73-30,411. Thesis (Ph.D.).

Thin film superconducting thermometers developed especially for high resolution measurements of the specific heat of liquid helium near its superfluid transition are described. These devices have $\partial R/\partial T \simeq 1.5 \times 10^6\ \Omega K^{-1}$ and temperature coefficients of resistance $R^{-1}(\partial R/\partial T) \simeq 260\ K^{-1}$ at mid-transition, and after preconditioning by aging and thermal cycling, are reproducible within the reproducibility of germanium resistance thermometers. The superconducting transition was shown to be a sensitive indicator of electromigration-induced change in thin aluminum films. Electromigration was shown to occur at cryogenic temperatures for ultra-thin aluminum films. The results also suggest that quantum resonances exist in the zero degree energy gap of these ultra-thin superconductors. Resistive peaks were observed in the transition curves of these very thin superconducting aluminum films. These were found on all parts of the transition curve, as opposed to only at the knee, as reported in the literature. A current dependence for the peaks was found. Curves with dual peaks were also observed, suggesting that the peaks occur for discrete values of some physical parameter. The temperature intervals between peaks appear to be integral multiples of an interval of about 30 millidegrees. (Diss. Abstr. Int., B)

Equipment and Devices

Refer also to abstracts 13288, 13320, 13327, 14442, 15014, and 15025.

14083 (IAE-2182) 100 kW AC GENERATOR WITH A SUPERCONDUCTING INDUCTOR. Veselovskii, A. S.; Vorob'ev, V. F.; Keilin, V. E.; Klimenko, E. Yu.; Kovalev, I. A.; Mironov, A. I.; Novikov, S. I.; Samoilov, B. N.; Rubinraut, A. M.; Chernoplekov, N. A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1972. 16p. (In Russian). INIS.

A description was given of the construction and test results of a 100 kv ac three-phase generator with superconducting exciting winding. The exciting winding consists of two solenoids separated by 180 mm. The internal diameter of the solenoids is 200 mm and the external diameter is 480 mm. The maximum magnetic field in the center of the system is above 2.5 tesla. The exciting winding and power housing are in a cryostat with a straight-through hori-

zontal aperture with diameter of 150 mm. In this aperture an armature of glass textolite is rotating. The armature winding is made from copper transposed wire. Cooling of the armature winding is by evaporation using liquid nitrogen. The rotation rate is 3000 ob/min. The external diameter of the armature is 140 mm. The length of the active zone is 200 mm. (tr-auth)

14084 (N-73-31627) LARGE SUPERCONDUCTING MAGNETIC SHIELD. Lundsten, R. H.; Scarzello, J. F. (Naval Ordnance Lab., White Oak, Md. (USA)). 1 Feb 1973. 33p. (NASA-CR-135486; NOLTR-73-113). NTIS $3.75.

A large superconducting magnetic shield was designed and constructed to provide a low intensity field in a temperature controllable volume approximately 30 cm (12 in) long by 10.2 cm (4 in) in diameter. Design, construction, and operating techniques are discussed and illustrated. This shield was built by the Naval Ordnance Laboratory (NOL) for the NASA Ames Research Center in support of its magnetic sensor research and lunar magnetic field modeling programs. (STAR)

14085 A NOVEL PARAMETIC NEGATIVE-RESISTANCE EFFECT IN JOSEPHSON JUNCTIONS. Kanter, H. (Electronics Research Laboratory, The Aerospace Corporation, Los Angeles, California 90009). Appl. Phys. Lett. 23: No. 6, 350-352 (15 Sept 1973).

The negative-resistance effect recently predicted for current-controlled highly damped Josephson junctions is experimentally demonstrated at a frequency of 9 GHz. Characteristically, the pump (or Josephson) frequency is smaller than the amplified one, and the pump mechanism is effective over a broad range of frequencies in contrast to the conventional parametric negative-resistance effect where the pump frequency exceeds that of signal and idler and where the frequency of operation is limited to a narrow range. The broad-band feature renders operation uncritical to tuning and bias voltage fluctuations. The fact that the junction is the element of lowest impedance in the circuit alleviates to a degree the matching problem generally encountered with Josephson contacts. (auth)

14086 SUPERCONDUCTING THIN-FILM QUANTUM GALVANOMETER. Decker, S.K.; Mercereau, J.E. (California Institute of Technology, Pasadena, California 91109). Appl. Phys. Lett. 23: No. 6, 347-349 (15 Sept 1973).

A refractory metal thin-film superconducting quantum galvanometer with a sensitivity of nearly 10^{-9} A has been developed. Design and construction are discussed and a model of finite-voltage operation of the galvanometer is presented. (auth)

14087 PROPERTIES OF Nb JOSEPHSON MICROBRIDGES. Laibowitz, R.B. (IBM Thomas J. Watson Research Center, Yorktown Heights, New York 10598). Appl. Phys. Lett. 23: No. 7, 407-408 (1 Oct 1973).

Electron-beam lithographic techniques have been used to fabricate Nb microbridges, and their superconducting properties have been investigated. A reduced T_c is found for some of the links, and microwave-induced steps and the temperature dependence of the critical current consistent with the Josephson effect are observed. (auth)

14088 SOLVABLE PAIR POTENTIAL FOR THE BOGOLIUBOV-DE GENNES EQUATIONS OF SPACE-DEPENDENT SUPERCONDUCTIVITY. Clinton, W.L. (Department of Physics, Georgetown University, Washington, D. C. 20007). Phys. Rev. B 8: No. 5, 1962-1964 (1 Sept 1973).

The Bogoliubov-de Gennes equations for the quasiparticle states of space-dependent superconductivity are solved exactly for a two-parameter pair potential representing a normal-metal-superconductor interface. For the simplest case of a superconductor filling the half-space $z > 0$, $\Delta(z, T) = [\Delta_0(T) + \Delta_1(T)e^{-z/\xi}]$, where Δ_0 is the bulk value of the gap and Δ_1 and ξ are variational parameters. For $T \sim T_c$, Δ_1 and ξ can be determined by minimizing the Ginzburg-Landau free-energy functional. In addition, the effect of self-consistency on the low-lying bound states of a superconductor-normal-superconductor junction is discussed. (auth)

14089 METHOD OF PRODUCING A COMPOSITE CONDUCTOR BAND FOR USE IN MAKING A TUBULAR SUPERCONDUCTOR. Diepers, H.; Musebeck, H. (to Siemens Aktiengesellschaft). US Patent 3,775,840. 4 Dec 1973. Priority date 19 Aug 1971, F. R. Germany. 4p.

A method is described for producing a conductor band which includes a layer of niobium adjacent to a layer of an electrically normal conducting metal and respective niobium chords defining the longitudinal edges of the band. The bimetal conductor band is produced by bending a niobium strip to have a U-shaped profile, at least approximately filling the space bounded by the inside surface of the U-shaped niobium strip with an electrically normal conducting metal, and then joining the normal conducting metal to the U-shaped niobium strip to form the band. The bimetal conductor band made in this manner is used in a method of producing a tubular conductor for superconducting cables and the like. (auth)

14090 HELICAL RESONATOR FOR VHF SQUID OPERATION. Corruccini, L.R. (The Aerospace Corporation, Los Angeles, California 90009). Rev. Sci. Instrum. 44: No. 9, 1256-1257 (Sept 1973).

A helical resonator for SQUID magnetometer operation in the 30 MHz-1 GHz frequency range is described. The device offers a convenient means of utilizing the expected linear increase in SQUID sensitivity with operating frequency throughout this range. Experimental results which demonstrate this effect at 460 MHz are presented. (auth)

14091 AN ADJUSTABLE rf-BIASED SQUID. Strayer, D.M.; Catchings, R.M.; Oversluizen, T.; Kitchens, T.A. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973). Rev. Sci. Instrum. 44: No. 9, 1434-1435 (Sept 1973).

A symmetric rf-biased point-contact superconducting quantum interference device, which can be adjusted while in operation at low temperatures, is described. The device retains the inherent stability and other features of the symmetric rf-biased SQUID while increasing its flexibility, reliability, and even convenience with a simple adjustment feature. (auth)

14092 HIGH-FIELD IRON MAGNETS: A COMPARISON WITH THEORY. Baynham, D. E.; Coupland, J. H.; Simkin, J. (Rutherford High Energy Lab., Chilton, Eng.). Nucl. Instrum. Methods; 114: No. 1, 169-170(1974).

Measurements of the field pattern in a superconducting dipole magnet are compared with prediction. The unresolved differences are probably due to iron anisotropy which is not included in the computations. (auth)

14093 IMPROVEMENTS IN AND RELATING TO FLUID TRANSFER MEANS. Wood, M. B. (to International Research and Development Co. Ltd.). British Patent 1,330,144. 12 Sep 1973. Filed date 27 Feb 1970. 4p.

Reference is made to rotary seal assemblies for use in the transfer of fluid between a stationary and a rotating body, with particular application to machines where large temperature differences exist between the fluid and stationary and/or rotating parts of the machine, such as in superconducting electrical machines. The assembly described comprises a vacuum-insulated duct in the stationary body terminating at a port in a vacuum-insulated wall, and a similar duct in the rotary body. The two walls define a space closed by a rotary seal or seals at a position remote from the ports, this space having such dimensions as to minimize flow through the space from the ports to the seals, thereby sustaining a substantial temperature difference between the fluid adjacent to the seals and that flowing between the ports. One of the walls may carry control fences extending towards the other wall and lying transverse to the direction of fluid flow and thus restricting the flow. The space between the walls may be of annular form, and the rotary body may be a shaft with the stationary body a housing surrounding the shaft, the annular space being coaxial with the shaft. The vacuum-insulated wall fixed to the shaft may carry a number of axially-spaced radially-extending flanges to restrict fluid flow through the space. Two axially-spaced rotary seals may be employed, each comprising a thrust ring bearing against a fixed collar on the shaft. (UK)

14094 CIRCUIT FOR CONTROLLING THE FIELD OF A SUPERCONDUCTING SOLENOID. Vatulin, I. F.; Lukin, S. N.; Oranskii, L. G.; Permyakov, V. V.; Podlesnyi, V. V.; Yurkovskii, Yu. I. (Donetsk Polytechnic Inst., Stalino, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 3, 839-840(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 3, 156-157(1973).

A circuit for voltage stabilization and sweeping of a magnetic field is described which is based on a superconducting solenoid. The circuit is especially convenient for use in devices that have a high inductance and do not require prolonged stability of the magnetic field. (auth)

14095 MAGNETIC MEASUREMENTS USING A SUPERCONDUCTING QUANTUM MAGNETIC-FLUX METER. Zavaritskii, N. V.; Legkostupov, M. S. (Inst. of Physics Problems, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 3, 909-912 (1973).

Translated from Prib. Tekh. Eksp.; 16: No. 3, 213-215(1973).

A procedure is described for performing magnetic measurements based on a superconducting quantum magnetic-flux meter (s.q.m.f.m.) in the temperature range 1.5 to 40°K and in magnetic fields ranging from 0 to 30 kOe. The sensitivity of the method to changes in magnetic flux amounts to $\sim 10^{-9}$ Oe·cm^2. The characteristics of the s.q.m.f.m. are presented, and recommendations are made concerning its adjustment. (auth)

14096 LOW-TEMPERATURE INDIUM SEAL. Korrovit-s, V. Kh. (Inst. of Physics and Astronomy, Tartu, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 3, 953(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 3, 248(1973).

An indium seal is described which operates reliably without vacuum lubrication in superfluid helium due to the tightening of the screws after single cooling with liquid nitrogen. (auth)

14097 ATTENUATION OF WAVES IN SUPERCONDUCTING ELLIPTICAL WAVEGUIDES. Novikov, S. A. (Tomsk Polytechnical Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 15: No. 12, 1944-1946(1972). (In Russian).

Formulas are derived for the coefficients of attenuation of E and H waves in terms of the surface impedance for superconducting elliptical waveguides. Curves are given for the coefficients of attenuation of odd and even modes at various eccentricity values for niobium waveguides at 4.2°K. Analogous curves could be plotted for other temperatures and materials. (JPRS)

14098 SUPERFLUID-TIGHT COAXIAL COUPLING. Flint, E. B.; Hallock, R. B. (Univ. of Massachusetts, Amherst). Rev. Sci. Instrum.; 44: No. 8, 1133(Aug 1973).

A coupling which facilitates the union of RG-174 to microaxial cable is described. Features of the coupling involve a superfluid seal to the microcoax and electrical connections which do not require special handling. (auth)

14099 NOISE THERMOMETRY AT ULTRALOW TEMPERATURES. Webb, R. A.; Giffard, R. P.; Wheatley, J. C. (Univ. of California, San Diego, La Jolla). J. Low Temp. Phys.; 13: No. 3/4, 383-429(Nov 1973).

The mean square Johnson noise currents flowing in a low-temperature series L-R circuit are used to measure absolute temperatures in a new method using an rf-biased superconducting magnetometer. In one set of experiments a quantitative study was made of the noise currents in a beryllium copper resistor located in the mixing chamber of a dilution refrigerator in the temperature range 5.4 mK to 4.2 K as a function of the magnetic temperature determined from measurements of the static magnetization of powdered CMN. In this temperature range the measured mean square noise current is found to be linearly proportional to T^* with a coefficient which agrees within the experimental accuracy of ±3% with the theoretically predicted value based on the Nyquist relation and independent measurements of all necessary calibration factors. A model for a SQUID operated in the flux-locked loop configuration with a partly resistive input circuit is presented and is used in the determination of the "device noise" temperature, which for the above experiment is found to be 0.16 ± 0.02 mK. A calculation is presented of the length of time necessary to average the output of the thermometer in order to achieve any desired precision in the estimation of the mean square Johnson noise currents, and a comparison with the observed precision is made. In a second set of experiments the relationship between the Johnson noise temperature of a copper resistor and the 16-Hz magnetic temperature of two powdered paramagnetic salts, CMN and CDP, each in the shape of a right-circular cylinder with diameter equal to height, located in an adiabatic demagnetization cell, was determined from 2 to 20 mK. The device noise temperature characterizing the measuring system for these experiments was measured to be ~0.05 mK. A discussion of the possible sources of inaccuracy associated with Johnson noise thermometry is presented. Particular attention is paid to the possibility of a heat leak directly to the noise resistor. (auth)

14100 NUCLEAR REFRIGERATION OF COPPER. Hensel, P. (Clarendon Lab., Oxford). J. Low Temp. Phys.; 13: No. 3/4, 371-382(Nov 1973).

Nuclear refrigeration experiments were performed on samples containing 0.93 g-atom of copper. After demagnetization to a field of 800 G from initial conditions of 25 kG and 16 mK, lattice temperatures of less than 1 mK were reached. The temperature of the copper nuclei was measured with a pulsed nuclear magnetic resonance thermometer. The lattice temperature was then calculated from this value and the experimentally determined heat leak of 0.10 ± 0.02 erg/sec. An attempt to measure the lattice temperature directly by observing the anisotropy in the angular distribution of the γ rays emitted by 1 μCi of ^{54}MnZn was not successful. A number of solutions of the differential equations describing nuclear refrigeration were obtained and were used to simulate experiments with various heat leaks and final magnetic fields. Calculations were also fitted to the experimental results wherever possible. (auth)

14101 APPLICATION OF A SQUID MAGNETOMETER TO NMR AT LOW TEMPERATURES. Meredith, D. J.; Pickett, G. R.; Symko, O. G. (Univ. of Lancaster, Eng.). J. Low Temp. Phys.; 13: No. 5/6, 607-615(Dec 1973).

Using a SQUID magnetometer, changes in the nuclear magnetization of copper are observed when the nuclear spins absorb rf power at resonance. Since the detected flux change is directly proportional to the change in static magnetization ΔM, this method offers higher sensitivity at low frequencies than conventional NMR which responds to dM/dt. The experimental arrangement for observing ΔM at temperatures below 1°K is described. The variation of signal amplitude with temperature and rf power is found to agree well with predictions from the Bloch equations. A comparison of the sensitivity of the SQUID magnetometer and conventional NMR methods shows the advantage of the new technique at low frequencies and for nuclear systems with broad lines and long spin-lattice relaxation times. (auth)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts 13230, 14233, 14276, 14277, 14307, 14483, 14487, and 14786.

14102 (IAEA-153) EVALUATION OF NEUTRON NUCLEAR DATA. Proceedings of a Panel on Neutron Nuclear Data Evaluation, Held in Vienna, August 30–September 3, 1971. (International Atomic Energy Agency, Vienna (Austria)). 1973. 480p. (In English and Russian). (CONF-710855-).

Separate abstracts were prepared for each of the 26 papers in this report. (RWR)

For abstracts of individual papers see: 14103–14116, 14200, 14237–14239, 14272, 14273, 14296–14300, and 14774.

14103 (IAEA-153, pp 1-68) REVIEW OF THE NEUTRON DATA EVALUATION ACTIVITIES, THE IMPORTANT EVALUATION NEEDS AND THE ASSESSMENT OF THESE NEEDS IN IAEA MEMBER STATES. Byer, T. A.; Schmidt, J. J. (IAEA, Vienna). 1973.

From proceedings of a panel on neutron nuclear data evaluation; Vienna, Austria (30 Aug 1971).

On the basis of a survey performed by the IAEA, the neutron data evaluation activities and needs in IAEA Member States are reviewed. The evaluation activities planned in those Member States with significant fast breeder reactor development programmes are discussed, in addition to the steps being taken to facilitate the automatic conversion of data between different evaluated data libraries. The review then focusses attention on the organizational procedures which have been adopted in different States towards assessing and fulfilling their needs for evaluated data, as well as the degree to which existing and available evaluated data libraries satisfy the needs of users. The paper concludes by outlining the types of problems encountered in manipulating large data libraries and generating multigroup cross section sets with limited computer facilities, such as exist in certain developing countries. (7 figures, 11 tables) (auth)

14104 (IAEA-153, pp 69-81) NEUTRON DATA EVALUATION STUDIES IN THE UNITED KINGDOM IN THE SECOND HALF OF 1971. Story, J. S. (Atomic Energy Establishment, Winfrith, Eng.). 1973.

From proceedings of a panel on neutron nuclear data evaluation; Vienna, Austria (30 Aug 1971).

A brief outline of the organization of the neutron data evaluation and measurement program in the United Kingdom is presented. The degree to which each of the complete files of the U. K. Nuclear Data Library (UKNDL) meets the current needs of users in the U. K. is then summarized in a qualitative manner. A more detailed review of the present and planned U. K. evaluation activities is also presented, along with a summary of the principal computer programs used for the manipulation of evaluated data, as well as for the analysis and calculation of neutron cross sections. (4 tables) (auth)

14105 (IAEA-153, pp 83-89) APPLICATION OF EVALUATED NUCLEAR DATA FILES AVAILABLE AT IAEA FOR REACTOR CALCULATIONS. Vertes, P. (Central Research Inst. for Physics, Budapest). 1973.

From proceedings of a panel on neutron nuclear data evaluation; Vienna, Austria (30 Aug 1971).

A program system was developed for handling of evaluated data files KEDAK and UKAEA and for calculation of multigroup constants from them. Production of reactor group constant libraries is discussed, and some test calculations are presented. (1 figure, 1 table) (auth)

14106 (IAEA-153, pp 91-95) REVIEW OF NUCLEAR DATA WORK FOR REACTORS IN INDIA. Rastogi, B. P.; Huria, H. C. (Bhabha Atomic Research Centre, Bombay). 1973.

From proceedings of a panel on neutron nuclear data evaluation; Vienna, Austria (30 Aug 1971).

The nuclear data work done in India in connection with the Indian Nuclear Power Program is reviewed. The work done on data evaluation and preparation of multigroup cross section libraries is discussed. Some of the difficulties experienced in the adaptation of evaluated nuclear data libraries are also discussed. A specific suggestion is made to the Agency's NDS to obtain and make available a few multigroup cross section sets. (auth)

14107 (IAEA-153, pp 97-99) NEUTRON NUCLEAR DATA EVALUATION ACTIVITIES IN JAPAN. Igarasi, S. (Japan Atomic Energy Research Inst., Tokai). 1973.

From proceedings of a panel on neutron nuclear data evaluation; Vienna, Austria (30 Aug 1971).

A brief description is given of the neutron nuclear data evaluation activities in Japan, as of August 1971. As an example, the evaluation work on fission product data is briefly introduced. (auth)

14108 (IAEA-153, pp 101-103) NUCLEAR DATA ACTIVITIES IN ROMANIA. Rapeanu, S. 1973.

From proceedings of a panel on neutron nuclear data evaluation; Vienna, Austria (30 Aug 1971).

The measurement and evaluation activities in the field of neutron data in Romania are briefly reviewed with special emphasis being given to the generation of multigroup constants from evaluated data libraries. (auth)

14109 (IAEA-153, pp 105-137) AUTOMATION OF THE PROCESS OF INFORMATION CHECKING FOR THE LIBRARY OF RECOMMENDED NUCLEAR DATA, PROGRAM POSOSHOK. Kolesov, V. E.; Krivtsov, A. S.; Solov'ev, N. A. 1973. (In Russian).

From proceedings of a panel on neutron nuclear data evaluation; Vienna, Austria (30 Aug 1971).

The program for the detection of random errors (POSOSHOK), written in the Algol-60 language for M-220 computers, was described. The POSOSHOK program was intended for checking the accuracy of the representation and self-consistency of the numerical data contained in the library of recommended nuclear data FEI. The program variant described deals with neutron cross sections, angular and energy distributions of secondary particles, and special quantities for neutrons. (JSR)

14110 (IAEA-153, pp 139-140) COMPARATIVE ANALYSIS OF EVALUATED NUCLEAR DATA FILES/PHILOSOPHY. Yiftah, S. (Israel Atomic Energy Commission, Yavne). 1973.

From proceedings of a panel on neutron nuclear data evaluation; Vienna, Austria (30 Aug 1971).

The steps which will be undertaken in performing a comparative analysis of four evaluated neutron data libraries, UKNDL, ENDF/BI, ENDF/BII, and KEDAK, are outlined. This study is aimed at shedding some light on the basic problem of whether the physics parameters of the fast breeder reactors presently being designed are a function of the specific evaluated data file used in the calculations. The types of comparative analysis which will be undertaken in this study are summarized. (auth)

14111 (IAEA-153, pp 203-207) ESTABLISHMENT OF COMPUTER LIBRARIES OF EVALUATED DATA AND ASSOCIATED COMPUTER PROGRAMS. Pearlstein, S. (Brookhaven National Lab., Upton, NY). 1973.

From proceedings of a panel on neutron nuclear data evaluation; Vienna, Austria (30 Aug 1971).

The preferable features of a computerized library for evaluated data are reviewed. The importance of checking and editing codes operating on the data library is discussed with examples given of their use. Format problems and their influence on the exchange of evaluated data libraries are also appraised. (auth)

14112 (IAEA-153, pp 209-210) TECHNICAL COMMENTS AND REMARKS ABOUT ENDF/B, KEDAK, AND UKNDL. Gur, Y.; Yiftah, S. (Israel Atomic Energy Commission, Yavne). 1973.

From proceedings of a panel on neutron nuclear data evaluation; Vienna, Austria (30 Aug 1971).

Some of the technical problems encountered in automatically handling evaluated data libraries are discussed. Recommendations for alleviating some of these difficulties are also presented. (auth)

14113 (IAEA-153, pp 211-212) REMARKS ABOUT UKNDL, ENDF/B-II, AND KEDAK LIBRARIES. Panini, G. C. (CNEN, Bologna). 1973.

From proceedings of a panel on neutron nuclear data evaluation; Vienna, Austria (30 Aug 1971).

Some notes on the nuclear data collections emerging from daily familiarity with the related data files are listed. Problems relating to formats and editing, representation of evaluated data, and conversion from one format to another are noted. (auth)

14114 (IAEA-153, pp 213-260) FORMAT OF LIBRARY OF RECOMMENDED NUCLEAR DATA ON THE DESIGN OF REAC-

TORS (STATUS IN MARCH 1971). Kolesov, V. E.; Nikolaev, M. H. 1973. (In Russian).

From proceedings of a panel on neutron nuclear data evaluation; Vienna, Austria (30 Aug 1971).

The format for the storage of information in the library of recommended nuclear data FEI was described. This includes in the input a special data classification according to the type of representation. This makes it possible to realize different methods of data assignment for any type of reaction and to expand substantially the possibilities of the system for the storage of recommended nuclear data. In the library the storage of neutron data in subgroup representations with different numbers of neutron subgroups is provided for. The subgroup representation is a convenient method of data assignment in the region of forbidden resonances. This format for the storage of data is an extended development of the format described previously. (tr-auth)

14115 (IAEA-153, pp 273-299) ROLE AND EFFICIENCY OF NUCLEAR THEORY IN EVALUATION OF RESOLVED AND UNRESOLVED RESONANCES. Ribon, P. (CEN, Saclay, France). 1973. (In English and French).

From proceedings of a panel on neutron nuclear data evaluation; Vienna, Austria (30 Aug 1971).

Various topics linked with the theories used to describe or to calculate the neutron cross section in the resonance region are briefly examined. The various formalisms utilized have specific fields of application; comparisons between the results of different formalisms are difficult, and dangerous. The theories predicting the statistical distributions of partial widths and of level spacings are well-known and verified, with some uncertainty on the number of degree of freedom, ν; but, the existence of correlations is generally not well established. The only one which is certain (between spacing) has probably little importance for reactor physics; an attempt is made to give some figures of the influence of ν and of these correlations on the calculated cross sections in the unresolved energy range. The problem of the representation of the data in this unresolved energy range is dependent on the variations with energy of the average data and on the existence of intermediate structures. Several methods can be considered, the probability distributions of cross sections being probably a very convenient one, if reactors physicists can use them. (4 tables) (auth)

14116 (IAEA-153, pp 301-303) ENERGY REGION OF RESOLVED AND UNRESOLVED RESONANCES: THE ACTIVITY OF THE CNEN NUCLEAR DATA GROUP IN BOLOGNA, ITALY. Motta, M. (CNEN, Bologna). 1973.

From proceedings of a panel on neutron nuclear data evaluation; Vienna, Austria (30 Aug 1971).

The CNEN Italian activities concerning the resonance region of neutron cross sections are briefly summarized. Some critical questions and needs involving the experimental and theoretical analysis of the resonances and the problems of the multilevel representation are also pointed out. (auth)

14117 LIE SERIES SOLUTION OF INVARIANT IMBEDDING NEUTRON TRANSPORT EQUATIONS. Hu, T. K. Norman, OK; Univ. of Oklahoma (1973). 169p. University Microfilms Order No. 73-31,480.

Thesis (Ph. D.).

The invariant imbedding neutron transport equations were studied by the iterative Lie series perturbation method, taking the first three terms of a Taylor series expansion as the solutions to the perturbed system, which has the same initial condition as the given equations, and using it as a starting solution in the iteration method. Three terms of the Lie series expansion were used in each process as a correction. The principal result from this investigation is that the iterative Lie series perturbation method is effective in solving the invariant imbedding transport equations. Numerical results obtained for the reflection function of a semi-infinite homogeneous slab were in excellent agreement with those by the Runge–Kutta method given by Bellman. The local truncation errors in the calculations were below 10^{-12}. Furthermore, because of fast convergence, the higher orders of the method are not necessary to yield accurate results. Also, with the variable step size controls, decreases in rounding errors are expected in comparison with the fixed step size calculations. From indirect comparison, the iterative Lie series perturbation method is faster than the Runge–Kutta method. (Diss. Abstr. Int., B)

14118 NONLINEAR TIME-DEPENDENT MULTIVELOCITY TRANSPORT EQUATIONS. Pao, C. V. (North Carolina State Univ., Raleigh). J. Math. Anal. Appl.; 44: No. 3, 725-744(Dec 1973).

The existence and uniqueness of a solution for a class of nonlinear multivelocity neutron transport equations are demonstrated, and a method for the determination of the solution is presented. A recursion formula for the construction of a solution by the method of successive approximations and an error estimate for approximate solutions are given. Both global and local solutions are discussed. The conditions imposed on the nonlinear equation are directly applicable to the linear multivelocity transport problem, and a recursion formula for this system is also given. In the process of approximations, only successive integrations are involved. This fact indicates a promising possibility for the calculation of numerical results by using a computer. A brief discussion of this possibility and the applicability of the results on nonlinear problems are included. (auth)

14119 SIMPLE RELATION FOR EFFECTIVE NEUTRON TEMPERATURE IN COLD MODERATORS WITH LATTICE VIBRATIONAL MODES. Utsuro, M. (Kyoto Univ., Osaka). J. Nucl. Sci. Technol. (Tokyo); 10: No. 7, 428-434(Jul 1973).

The effective neutron temperature in cold hydrogenous solid moderators is analyzed in phonon approximation with use made of two simple models representing the frequency distribution of lattice vibrations; and simple relations are derived between the variation of the effective neutron temperature and the moderator temperature, as also, an equation expressing the limiting neutron temperature in a moderator at absolute zero temperature. Good agreement is obtained between the calculated and experimental results in cold light water ice. It is indicated that unbounded cooling of the moderator is not necessarily effective in improving the moderating efficacy, in the case of slowing-down by lattice vibrations; it generally suffices to cool the moderator down to the limiting neutron temperature. It is revealed that approach of the neutron temperature to the limiting value is largely determined by the shape of the frequency distribution of the lattices, while the limiting value itself is influenced by such parameters as the Debye temperature, the molecular mass and the ratio of absorption to the scattering cross section in the moderator. As a result of the present analysis, a general method for comparing and evaluating various solid moderators for cold neutrons has been established for practical use. (auth)

14120 COLLIDED FLUX EXPANSION METHOD FOR TIME-DEPENDENT NEUTRON TRANSPORT. Ganapol, B. D.; Grossman, L. M. (Univ. of California, Berkeley). Nucl. Sci. Eng.; 52: No. 4, 454-460(Dec 1973).

The neutron transport equation for a localized isotropic burst of neutrons in plane geometry can be represented as an infinite set of equations. Kholin has solved these equations, expressing the neutron density in terms of an infinite series of integrals. These integrals are evaluated numerically by either a recursion relation or a Chebyshev–Gauss quadrature approximation. The neutron density found by this method serves as an analytic "benchmark" to which other solutions to the time-dependent transport equation can be compared. A new closed form of the solution is also derived. (3 figures) (auth)

14121 INTEGRATION OVER DISCONTINUOUS TRIAL FUNCTIONS IN FLUX SYNTHESIS. Butler, D. K. (Argonne National Lab., IL). Nucl. Sci. Eng.; 52: No. 4, 492-494(Dec 1973).

The mathematical difficulties that arise when discontinuous trial functions are substituted into functionals appropriate for continuous functions are investigated by formulating the problem in terms of the mathematically acceptable properties of step functions and their derivatives. The expectable mathematical difficulties are shown to appear in the form of integrals that do not have mathematically defined values. The difficulties can be averted by replacing the integrals with approximate expressions which yield the familiar expressions for coupling across discontinuities. The problem of overdetermining the coupling coefficients appears to be avoidable by consistent application of the approximation. (auth)

14122 INITIAL CONDITION IN THE THEORY OF NEUTRON TRANSPORT. Kyncl, J. (Ustav Jaderneho Vyzhumu, Rez, Czech.) Apl. Mat.; 17: No. 4, 245-253(Aug 1972).

The transport equation is discussed for neutron density in a non-multiplying medium assuming a preset initial distribution. The macroscopic scattering cross sections of the medium and the density of neutron sources are considered to be general functions of position, angle, energy, and time. The results concerning the existence and the uniqueness of the solution are summarized in two fundamental theorems. (auth)

14123 NEUTRON TRANSPORT INITIAL VALUE PROBLEM IN NON-MULTIPLYING MEDIUM. Kyncl, J. (Ustav Jaderneho Vyzhumu, Rez, Czech.). Apl. Mat.; 17: No. 4, 254-266(Aug 1972).

The transport equation is discussed for neutron density in a non-multiplying medium assuming the initial neutron density distribution is known. The characteristics of both the medium and the neutron sources are considered to be a function of time. The existence and the uniqueness of the initial problem were proved

and some of the earlier results obtained by the author were generalized. The behavior is briefly discussed of Knudsen's gas in a thermal bath. (auth)

14124 ANALYTICAL METHOD TO CALCULATE RESONANCE ABSORPTION OF THERMAL NEUTRONS IN INFINITE, HOMOGENEOUS MODERATORS. Essig, C. Karlsruhe, Ger.; Univ. Karlsruhe (1973). 69p. (In German).

Thesis.

An analytical model was developed to calculate the influence of resonance absorption on neutron spectra in the thermal range. By using a suitable scattering kernel, it is possible to transform the Boltzmann equation to a linear differential equation of the 2nd order and to describe the solution in the form of an orthonormal system of modified Laguerre functions. This method was used with success for the calculation of thermal neutron spectra in homogeneous mixtures of moderators (H_2O and D_2O) and resonance absorbers (^{113}Cd and ^{239}Pu). (9 figures) (GE)

14125 CALCULATION OF THE THERMAL NEUTRON SCATTERING LAW. Rapeanu, S.; Padureanu, I.; Deciu, N. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 18: No. 8, 997-999(1973).

The scattering law S (α,β), both for small and large momentum and energy transfers is calculated. The calculations were performed in the incoherent and gaussian approximations. The ELIN code for computing the scattering law is used. (auth)

14126 PARALLEL SHOOTING SOLUTION OF THE NEUTRON TRANSPORT EQUATION IN SPHERICAL GEOMETRY. Canosa, J.; Penafiel, H. R. (IBM Corp., Palo Alto, CA). J. Comput. Phys.; 13: No. 3, 380-397(Nov 1973).

A direct and efficient parallel-shooting method is given for the solution of the spherical harmonics approximation to the neutron transport equation in spherical geometry with arbitrary anisotropic scattering and source. The special numerical difficulties due to the singularity at the center of the sphere are solved in a simple and efficient way. The algorithm "measures" the roundoff instability of the problem and eliminates it by performing a minimum of matrix transformations that ensure the linear independence of the matrix columns. (auth)

14127 NEUTRON TRANSPORT DURING A NUCLEAR AIR BURST, DERIVED BY MONTE CARLO CALCULATIONS. Laaksonen, J. (Technical Research Centre, Otaniemi, Finland); Jauho, P.; Kalli, H. Acta Polytech. Scand., Phys. Nucl. Ser.; No. 94, 1-26(1973).

The work described is an attempt to determine the energy, space and time distribution of neutrons resulting from an air burst of a nuclear device. Calculations were performed on the UNIVAC 1108, using Fortran V as the programming language. The Monte Carlo coding utilized in the work is developed by the authors; cross-sections are those of Bondarenko (1964). (auth)

14128 COLLISION PROBABILITY METHOD FOR CALCULATION OF ENERGY-DEPENDENT FLUX DISTRIBUTIONS IN MULTIDIMENSIONAL SYSTEMS WITH ARBITRARY BOUNDARY CONDITIONS. Detrick, C. A. Pittsburgh; Carnegie Mellon Univ. (1973). 282p. University Microfilms Order No. 73-18,322.

Thesis (Ph. D.).

A method was developed for the calculation of local neutron fluxes and reaction rates in multidimensional systems directly from integral transport theory. The method may also be used to produce space and spectrum averaged nuclear cross sections. The development was carried out for the continuous energy model in any arbitrary geometry for any number of dimensions with arbitrary boundary conditions on the region of solution. The method was extended to the multigroup energy representation and the matrix formulation of the method was demonstrated. The method is based on the first flight collision probabilities technique which described neutron transport by the probability for a neutron emitted in one location to travel without collision to another location and undergo its first collision at the second location. The first flight collision probabilities are used in neutron balance statements relating the integral number of collisions in each subdivision of the region of solution and the leakage out of the region to the neutrons emitted from scattering, fission, or fixed sources in all subdivisions. These balance statements provide a set of simultaneous equations which can be solved for the energy-dependent neutron fluxes in each subdivision of the region of solution. The method preserves neutron balance for the entire system. Linear anisotropy in neutron scattering has been incorporated in the method. An application of the method was programed in FORTRAN IV for use in the solution of the neutron balance equations by digital computational methods. This program, called FLXSLN, performs a successive overrelaxation iterative solution of the distributed fixed source problem for multiregion, multigroup, multidimensional reactor systems with arbitrary boundary conditions, providing the integral absorption, scattering, production, and collision rates and the integral neutron fluxes for each energy group in each subregion. The program also provides an estimate of the infinite medium multiplication factor for the system, the directional leakage currents and probabilities for each boundary, and nuclear cross sections averaged over the entire region of solution and collapsed into the desired number of energy groups using spectrum weighting. The first flight collision probabilities are left as input to the program allowing the use of any of the available methods deemed suitable or the development of new methods. Calculations were performed with FLXSLN for typical boiling water reactor fuel assembly sections in two-dimensional Cartesian geometry in two and six energy groups, with thermal energy upscattering included in the six group calculations and various boundary conditions on the two group computations. The same systems were calculated using a conventional Monte Carlo method. Comparisons were made between the local fractional absorptions and illustrations of the spatial characteristics of the two methods are included. (Diss. Abstr. Int., B)

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Refer also to abstracts 13832, 13834, 13837, 13941, 14213, 14237, and 14239.

14129 (COO-535-693, pp 10-11) SCATTERING OF 27-MeV PROTONS BY POLARIZED ^3He. Ware, R. H.; Ingalls, P. D.; Smythe, W. R. 1 Nov 1973.

In Nuclear Physics Laboratory technical progress report, November 1, 1972–November 1, 1973.

14130 (JINR-P1-7231) TOTAL CROSS SECTION FOR THE DOUBLE CHARGE EXCHANGE REACTION $\pi^+ + {}^4He \rightarrow \pi^- + 4p$ AT 100 MeV. Kulyukin, M. M.; Lyashenko, V. I.; Pontekorvo, D. B.; Falomkin, I. V.; Shcherbakov, Yu. A.; Georgescu, C.; Mihul, A.; Nichitiu, F.; Sararu, A.; Piragino, G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The total cross section of the double charge exchange reaction $\pi^+ + {}^4He \rightarrow \pi^- + 4p$ was measured using a high pressure helium filled streamer chamber, triggered by a scintillation hodoscope. Measurements were carried out in the range of angles from 25 to 165°. The total cross section turned out to be $\sigma_{tot} = (0.30 \pm 0.15) \cdot 10^{-27}$ cm^2. (auth)

14131 (LA-5412-T) POLARIZATION TRANSFER IN PROTON–DEUTERON ELASTIC SCATTERING. Mitchell, C. K. (Los Alamos Scientific Lab., N.Mex. (USA)). Nov 1973. Contract W-7405-eng-36. 172p. Dep. NTIS $7.60.

Vector-to-tensor polarization transfer coefficients in proton–deuteron elastic scattering have been measured at outgoing deuteron laboratory angles of 0°, 22.5°, and 45° in the energy range 4.1 MeV ≤ E_p ≤ 9.1 MeV. The various vector-to-tensor polarization transfer coefficients are consistent with zero, in view of the errors, but effects of the order of ~0.05 cannot be ruled out. The $^3He(\vec{d},p)^4He$ reaction near the 430 keV resonance was used as the deuteron tensor polarization analyzer. Recently calculated vector-to-tensor polarization transfer coefficients agree well with the present measurements though there is some structure near a c.m. angle of 120° (corresponding to an outgoing deuteron laboratory angle of 30°). This class of transfer measurements seems to be somewhat insensitive to changes in the scattering amplitudes. Calculations of vector-to-vector polarization transfer coefficients, on the other hand, are large and appear more sensitive to such changes–both in $D(\vec{p},\vec{p})D$ and $D(p,d)H$ elastic scattering. (LBS)

14132 ANALYZING POWER FOR d-^{4}He ELASTIC SCATTERING AT 12.0, 14.0, AND 17.0 MeV. Ohlsen, G.G.; Lovoi, P.A.; Salzman, G.C.; Meyer-Berkhout, U.; Mitchell, C.K.; Grüebler, W. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). Phys. Rev. C 8: No. 4, 1262-1268 (Oct 1973).

Angular distributions of the analyzing tensors for d-^{4}He elastic scattering in the angular range 30–145 ° (c.m.) and at 12, 14, and 17 MeV are presented. An over-all absolute precision of about ± 0.01 is obtained. In addition to the complete angular distributions, data were taken in a fine mesh near 12 MeV, 37 ° (lab), where the analyzing tensor A_{yy} apparently approaches unity. The manner in which it can be decided whether or not A_{yy} goes to exactly unity is discussed. If this is found to be the case, a valuable absolute polarization standard will be available. (auth)

14133 98° DIFFERENTIAL CROSS SECTION FOR THE REACTION ^{4}He(γ, n)^{3}He. Irish, J.D.; Johnson, R.G.; Berman, B.L.; Thomas, B.J.; McNeill, K.G. (Department of Physics, University of Toronto, Toronto, Ontario, Canada M5S 1A7); Jury, J.W. Phys. Rev. C 8: No. 4, 1211-1214 (Oct 1973).

The 98 ° differential photoneutron cross section for ^{4}He has been measured for excitation energies between 22 and 33 MeV with a liquid ^{4}He target at its normal boiling point and for excitation energies between 23 and 37 MeV with a ^{4}He gas target at a pressure of 51.6 bars. The cross section values obtained with the gas target were approximately a factor of 1.9 greater than those obtained with the liquid target. This apparent dependence of the cross-section upon the physical state of the ^{4}He target may explan the large values for the ratio σ (γ, p)/σ (γ, n) obtained by comparing photoneutron and photoproton cross sections obtained with targets in different physical states. (auth)

14134 INTERACTION OF 24.0- AND 27.2-MeV NEUTRONS WITH DEUTERONS. Burrows, T.W. (University of Wisconsin, Madison, Wisconsin 53706). Phys. Rev. C 8: No. 4, 1173-1178 (Oct 1973).

The angular distributions of 24.0- and 27.2-MeV neutrons scattered elastically by deuterons through angles between 90 and 166 ° (c.m.) were measured. Proton-emission-energy spectra were studied at 11 and 22 ° (lab) and angular distributions were measured between 11 and 46 ° (lab). The spectra and angular distributions were normalized to the n-p differential cross section at 158 ° (c.m.). The minimum cross sections of neutrons elastically scattered by deuterons were found to be less than the minimum cross sections of elastically scattered protons. (auth)

14135 SOLAR NEUTRINOS FROM THE ^{3}He(p, e$^+\nu$)^{4}He REACTION. Werntz, C.; Brennan, J.G. (The Catholic University of America, Washington, D.C. 20017). Phys. Rev. C 8: No. 4, 1545-1546 (Oct 1973).

The cross section for the β^+ decay of continuum states of ^{4}Li has been recalculated using an improved normalization for the S-wave proton inside the nucleus and the newly measured value of the thermal-neutron capture cross section of ^{3}He. In addition, the contributions of first-forbidden transitions have been added. The new value of the S factor is found to be 8.1×10^{-20} keV b, too small for this reaction to produce a measurable flux of solar neutrinos on Earth. (auth)

14136 TOTAL CROSS SECTION OF NEUTRONS ON DEUTERIUM IN THE keV REGION. Stoler, P.; Kaushal, N.N.; Green, F. (Rensselaer Polytechnic Institute, Troy, New York 12181). Phys. Rev. C 8: No. 4, 1539-1541 (Oct 1973).

Total neutron cross sections on deuterium in the energy range 1 to 1000 keV have been measured, and basically agree with our previously reported results. (auth).

14137 SEPARABLE-INTERACTION MODEL FOR DEUTERON BREAKUP. Wallace, J.M. (Department of Physics and Astronomy and Center for Theoretical Physics, University of Maryland, College Park, Maryland 20742). Phys. Rev. C 8: No. 4, 1275-1284 (Oct 1973).

This paper is the second in a planned series of papers in which is developed an exactly soluble three-nucleon model for describing Nd scattering processes at energies above 30 MeV. The model described here is a small refinement of the one previously described. It is obtained from the low-energy three-body model of Aaron, Amado, and Yam by a simple modification of the S-wave separable two-body amplitudes to fit two-nucleon elastic scattering data at higher energies. By comparison of the calculated differential cross sections with experiment at proton projectile energies of 46, 65, 85, 100, and 156 MeV, the model is shown to provide a reasonable description of the ^{2}H(p, 2p) and ^{2}H(p, pn) reactions throughout this energy range. Some quantitative justification for the two-nucleon amplitudes employed supplants the hand-waving arguments of the first paper. (auth)

14138 T-MATRIX PERTURBATION THEORY FOR THE THREE-NUCLEON SYSTEM WITH THE REID POTENTIAL. Afnan, I.R.; Read, J.M. (School of Physical Sciences, Flinders University of South Australia, Bedford Park, South Australia, 5042.). Phys. Rev. C 8: No. 4, 1294-1300 (Oct 1973).

The binding energy of ^{3}H for the Reid soft-core $^1S_0$ and $^3S_1$–$^3D_1$ potentials was determined, using T-matrix perturbation theory, to be 7.02 MeV. The one-term separable approximation to the Reid potential, constructed using the deuteron wave function in the $^3S_1$–$^3D_1$ channel and the form factor associated with the antibound state in the $^1S_0$ channel, gave a binding energy of 7.15 MeV. This is close enough to the exact answer to be very useful in realistic three-nucleon calculations. It also demonstrates the important contribution that the two-body bound-state wave functions make to the triton binding energy. (auth)

14139 SEARCH FOR DOUBLY RADIATIVE np CAPTURE. Arnold, R.G.; Chertok, B.T. (The American University, Washington, D. C. 20016); Schröder, I.G.; Alberi, J.L. Phys. Rev. C 8: No. 4, 1179-1184 (Oct 1973).

We have made a search for doubly radiative np capture $n + p \rightarrow \gamma_1 + \gamma_2 + D$. It has been suggested that this process might contribute to the total np-capture cross section and thus explain the long-standing discrepancy in np capture ($\sigma_{expt} = 334.2 \pm 0.5$ mb and $\sigma_{th} = 302.5 \pm 4.0$ mb). Previous np-capture experiments have been insensitive to the energy distribution of the capture γ rays. In this experiment we searched for two-photon events by looking for γ rays in coincidence from a H_2O target exposed to a beam of thermal neutrons using two 5 × 5-cm NaI detectors. Analysis of the coincidence spectra indicates two-photon np-capture events have not been observed. An upper limit at the 3 standard deviation confidence level of $\sigma_{2\gamma} \leq 1.0$ mb can be placed on the doubly radiative np-capture cross section. Therefore the two-photon cross section does not explain the discrepancy between the theoretical and experimental np-capture cross sections. (auth)

14140 CHARGE ASYMMETRY EFFECTS AND THE TRINUCLEON BINDING-ENERGY DIFFERENCE. Gibson, B.F.; Stephenson, G.J. Jr. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). Phys. Rev. C 8: No. 4, 1222-1225 (Oct 1973).

We demonstrate, using a separable-potential model, that the discrepancy between the observed ^{3}H-^{3}He binding-energy difference and the calculated Coulomb energy does not necessarily imply that $|a_{nn}| > |a_{pp}|$. This possibility arises from the relative insensitivity of the trinucleon binding energy to the scattering length as compared to the sensitivity to the effective range. (auth)

14141 NEUTRON POLARIZATION FROM ^{2}H(p, $\vec{n}$) AND ^{1}H(d, $\vec{n}$). Rad, F.N.; Northcliffe, L.C.; Saylor, D.P.; Rogers, J.G.; Graves, R.G. (Cyclotron Institute, Texas A & M University, College Station, Texas 77843). Phys. Rev. C 8: No. 4, 1248-1254 (Oct 1973).

Measurements of the neutron polarization in the p-d breakup reaction are reported. The polarization of breakup neutrons from ^{2}H(p, $\vec{n}$) has been measured at $E_p = 21.4$ MeV, $\theta_{lab} = 18$ °, as a function of neutron energy with an accuracy of approximately ± 0.01. The measurement is consistent with zero from 8 to 13 MeV, but shows a small but significant positive polarization from 14 to 18 MeV. A similar measurement of the breakup neutrons from the ^{1}H(d, $\vec{n}$)2p reaction at the same center-of-mass momentum ($E_d = 42.8$ MeV), also at $\theta_{lab} = 18$ ° shows nonzero polarization which peaks to about − 0.05 ± 0.01 over the neutron energy region 8 to 25 MeV. In both cases, the polarization of the breakup neutrons is opposite in sign to that expected if the dominant process is simple quasifree scattering. (auth)

14142 APPROXIMATED METHODS FOR SOLUTION OF THREE-NUCLEON PROBLEM AT POSITIVE ENERGIES. Belyaev, V. B.; Efimov, V. N.; Tkachenko, E. G.; Shul'ts, G. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 18: No. 4, 779-786(Oct 1973). (In Russian).

The quartet nd scattering with point-like interaction is considered at energies above the deuteron break up. The arising integral equation is solved by two independent methods. The first one is based on the Faddeev theorem stating smoothness of the iterated kernels. In this case the solution is obtained in an analytic form by expanding the iterated kernels in system of orthogonal function chosen in an adequate way. The second method is based on the assumption of the (pieceweise) smoothness of the solution, that is approximated by a sum over the Langrange interpolating polynomials in the region where kernel singularities are located. The result is that the problem is reduced to solution of a set of algebraic equations for values of the unknown function in the interpolation points. Both the solutions coincide up to a few percent for neutron energies of the incident below 14 MeV. (auth)

14143 BEHAVIOR OF THE PROCESS ^{3}He(e,e′p)^{2}H CROSS SECTION AT LARGE ENERGIES OF THE REACTION FRAGMENT RELATIVE MOTION. Tartakovskii, V. K. (Kiev State Univ.). Yadern. Fiz.; 18: No. 4, 795-800(Oct 1973). (In Russian).

The dependence of the two-particle He^3 electrodisintegration cross section on the final-state interaction in the case where the proton and deutron relative motion have a large energy is investigated. The interaction between the reaction fragments is described in the diffraction approach. The angular distributions of the produced protons and the energy and angular distributions of the scattered electrons are calculated. It is shown that these distributions depend appreciably on the final state interaction at large energies of the proton-deutron relative motion. (auth)

14144 INTERMEDIATE ENERGY NUCLEON–DEUTERON ELASTIC SCATTERING. Wilson, J. W. (Langley Research Center, Hampton, VA). Nucl. Phys.; B66: 221-244(1973).

A fully symmetrized multiple-scattering series is considered for the formulation of nucleon-deuteron elastic scattering. An off-shell continuation of the experimentally known two-body amplitudes that retains the exchange symmetries required for the calculation is presented. The one-boson exchange terms are evaluated exactly in this off-shell prescription. The first two terms of the multiple-scattering series are calculated explicitly whereas multiple-scattering effects are obtained as minimum

variance estimates from the 146 MeV data of Postma and Wilson. The multiple-scattering corrections indeed consist of low-order partial waves as suggested by Sloan based on model studies with separable interactions. The Hamada–Johnston wave function is shown consistent with the data for internucleon distances greater than about 0.84 fm. (auth)

14145 ISOBAR MECHANISM OF THE PION DOUBLE CHARGE EXCHANGE AT HIGH ENERGY. Dal'karov, O. D.; Kolybasov, V. M. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 18: No. 4, 809-816(Oct 1973). (In Russian).

The mechanism of the reactions of the (π^+,π^+) type on nuclei is considered with production of a virtual isobar followed by its rescattering. Moving singularities of the corresponding Feynman diagram for the charge exchange on carbon and deuterium are studied quantitatively taking and not taking into account the nuclear formfactor. The sensitivity of the results to the kind of the nuclear formfactor is investigated. Possible background effects are briefly discussed. (auth)

14146 KAON IN FLIGHT EXCITATION OF STRANGENESS ANALOG STATES. Deloff, A. (Inst. for Nuclear Research, Warsaw). Nucl. Phys.; B67: No. 1, 69-92(1973).

Strangeness-exchange reactions induced by kaons in flight on nuclei have been investigated. A two-channel optical potential is derived by folding a suitably chosen $\bar{K}N$ potential that reproduces the $\bar{K}N$ reaction data into the nucleon density. The deduced potential, invariant with respect to the SU(3) Sakata symmetry, describes elastic scattering and the reaction in which the kaon is transformed into a pion, and the target into a strangeness analog state that belongs to the same SU(3) supermultiplet. The calculated cross sections for the excitation of strangeness analog states are for light elements of the order of a few millibarns and show broad giant resonance-like maxima. (auth)

14147 DEUTERON AND TRITON DECAY WIDTHS IN THE CONTINUUM SHELL MODEL. Tarnoveanu, I. G. (Pallas Lyceum of Agriculture, Constanta, Romania); Dumitrescu, O.; Sandulescu, A. Rev. Roum. Phys.; 18: No. 7, 825-834(1973).

In the continuum shell model the explicit expressions for the deuteron and triton decay widths are obtained. For the continuum shell model wave functions the solutions of the corresponding coupled channel equations obtained by the procedure which consists in the expansion of the radial part of the single particle continuum states in a product of a Gauss function and an expansion in radial harmonic oscillator wave functions were used. (auth)

14148 NONCOPLANAR CORRELATION SPECTRA FROM THE ^{2}H(p,2p)n REACTION AT E_{inc} = 44.9 MeV. Shannon, D. L. (Univ. of California, Los Angeles); Breunlich, W.; Slaus, I.; Sunier, J. W.; Anzelon, G.; Tin, E.; Van Oers, W. T. H.; Epstein, M. B.; Ebenhoeh, W. Nucl. Phys.; A218: No. 2, 381-395(1974).

The differential cross section $d^3\sigma/d\Omega_3 d\Omega_4 dE_3$ for the ^{2}H(p, 2p)n reaction at E_{inc} = 44.9 MeV is measured in noncoplanar geometry. The Amado model in general gives a good fit to the absolute cross section. The dependence of the cross section on the momentum of the undetected particle Q_5, on the scattering angle θ_{34}, as well as on the angle of the undetected particle is investigated. (auth)

14149 TWO NUCLEON t-MATRIX AND THE PROPERTIES OF THE THREE-NUCLEON SYSTEM. Bahethi, O. P. Buffalo; State Univ. of New York (1973). 169p. University Microfilms Order No. 73-29,070.

Thesis (Ph. D.).

A closed form expression for the s-wave part of the Hulthén potential's t-matrix is derived. This expression is used to obtain a simpler result for the terms in the Weinberg series for the t-matrix than the result given previously. It is shown that the pure boundary condition model (BCM) t-matrix obtained from the Hoenig-Lomon pseudopotential does not satisfy the analyticity requirements suggested by Brayshaw, since the t-matrix possesses unphysical poles. A closed form expression is derived for the t-matrix which arises when the external potential in the BCM is taken to be a square well. A separable expansion for the t-matrix is also derived and compared numerically with the closed form result. The rate of convergence is found to be fast enough to be of practical value in calculations on the three-nucleon system. Results of calculations on the three-nucleon system are presented for two potentials: a spin-dependent square well potential acting in s-waves and a spin-dependent rank one separable potential which gives the same s-wave phase shifts and deuteron binding energy as the square well. It is found that large differences exist in the two-particle t-matrices for certain values of momenta and energy. It is also found that significant differences exist in the three-nucleon properties calculated with these potentials. The effect of short range repulsion in the nuclear interaction on the low energy properties of the three-nucleon system is investigated by comparing the results of calculations with two potentials: a hard core square well potential and a potential having a nonlocal repulsion and a square well attraction. No significant differences in the binding energy of the triton and the n–d scattering lengths are found with these potentials. (Diss. Abstr. Int., B)

Nuclear Properties and Reactions, 6 ≤ A ≤ 19

Refer also to abstracts 14145, 14175, 14179, 14185, 14197, 14209, 14233, 14238, 14264, and 14306.

14150 (COO-535-693, pp 4-6) (d,d*) AND (d,p) REACTIONS ON ^{12}C AT 17.3 MeV. Munger, M. L.; Peterson, R. J. 1 Nov 1973.

In nuclear physics laboratory technical progress report, November 1, 1972–November 1, 1973.

14151 (COO-535-693, pp 42-44) COMPARISON OF (p,n) REACTION CROSS SECTION WITH ACTIVITY MEASUREMENT FOR ^{13}C. Lind, D. A.; Peterson, R. J.; Fielding, H. 1 Nov 1973.

In nuclear physics laboratory technical progress report, November 1, 1972–November 1, 1973.

14152 (COO-535-693, pp 44-47) DIFFERENTIAL CROSS SECTIONS FOR ^{10}B(p,n)^{10}C AND ^{11}B(p,n)^{11}C AND SOME MACROSCOPIC REACTION RELATIONSHIPS. Goodman, C. D.; Fielding, H. W.; Lind, D. A. 1 Nov 1973.

In nuclear physics laboratory technical progress report, November 1, 1972–November 1, 1973.

14153 (FRNC-TH-418) SCATTERING OF 6.4-MeV NEUTRONS BY ^{12}C, ^{31}P, ^{59}Co, ^{75}As, ^{127}I, AND ^{209}Bi. Ramstein, B. (Nancy-1 Univ., 54 (France)). 1973. 109p. (In French). Dep. NTIS (U.S. Sales Only) $7.50.

Thesis.

The following total cross sections (expressed in millibarns) were obtained for the elastic scattering of neutrons: 780 ± 40 (carbon 12); 2070 ± 120 (cobalt 59); 1730 ± 100 (iodine 127); 1130 ± 70 (phosphorus 31); 2400 ± 130 (arsenic 75); 3450 ± 220 (bismuth 209). Analysis made in the framework of the spherical optical model led to satisfactory explanations of the measured differential cross sections. Nevertheless, for the case of deformed nuclei, it would be advisable to re-analyze the experimental results using the coupled channel model. (FR)

14154 (IFVE-SEF-73-22) ABSORPTION CROSS SECTIONS FOR PIONS, KAONS, PROTONS, AND ANTIPROTONS ON COMPLEX NUCLEI IN THE 6 TO 60 GeV/c MOMENTUM RANGE. Gorin, Yu. P.; Denisov, S. P.; Donskov, S. V.; Krasnokutskii, R. N.; Petrukhin, A. I.; Prokoshkin, Yu. D.; Stoyanova, D. A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1973. 25p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.25.

Absorption cross sections for $\pi^\pm$-, $K^\pm$-mesons, protons and antiprotons on Li, Be, C, Al, Cu, Sn, Pb and U in the momentum range from 6.65 to 60 GeV/c are measured at the 70 GeV IHEP accelerator. The cross sections are compared with calculations on Glauber multiple scattering model. Nuclear radii, which are described by power dependence on atomic weight $R = r_0 A^{\frac{1}{3}}$, where r_0 = (1.05 ± 0.02) fm are defined. (auth)

14155 (ORO-3815-3) STUDIES OF THE CROSS SECTIONS OF ^{3}H, ^{3}He, ^{4}He, AND ^{14}C IN THE BOMBARDMENT OF CARBON AND OXYGEN WITH HIGH-ENERGY PROTONS. Heymann, D.; Kruger, S. (Rice Univ., Houston, Tex. (USA)). Aug 1973. Contract AT(40-1)-3815. 237p. Dep. NTIS $14.00.

The proposed research under contract AT-(40-1)-3815 called for the study of the yields of ^{3}H, ^{3}He, ^{4}He, and ^{14}C in carbon and oxygen bombarded by high energy protons. Only ^{3}H, ^{3}He, and ^{4}He could be determined. The proposal called for proton energies of 450, 600, 3000, 6000, and 30,000 MeV. Of these, only 600, 3000, and 30,000 (actually 33,000) MeV could be done. The objectives: to settle more firmly the value of the ^{4}He/(^{3}He + ^{3}H) and ^{3}H/^{3}He production rates in systems containing substantial amounts of oxygen, to test theories on spallation and fragmentation of C and O by high energy protons, and to obtain data of potential interest for cosmic-ray physics and related cosmochemical problems, were substantially fulfilled. (auth)

14156 (ORO-3924-14) ANGULAR MOMENTUM EFFECTS IN NUCLEAR REACTIONS. 1973 Progress Report. Natowitz, J. B. (Texas Agricultural and Mechanical Univ., College Station (USA). Cyclotron Inst.). 1973. Contract AT(40-1)-3924. 45p. Dep. NTIS $4.25.

A summary of research performed during the period 1 January 1973–31 December 1973 is presented. Counter telescopes have

been employed to measure the energy spectra and angular distributions of nuclei produced in the reactions of 100-197 MeV ^{12}C with ^{12}C and ^{27}Al target nuclei. Fusion cross sections and elemental yield distributions have been obtained. Statistical model calculations are being employed in combination with this data to explore the location of the yrast line in highly excited nuclei. For ^{39}K nuclei produced in the reaction of 180 MeV ^{12}C ions with ^{27}Al the limiting angular momentum for fusion is 40ħ and the fission cross section is found to be ≤ 180 mb. Further studies of fission of the light elements are in progress. A study of fission and α decay in neutron deficient Am isotopes has confirmed the existence of long lived ($T_{\frac{1}{2}} > 1s$) fission activities produced in the irradiation of ^{230}Th with ^{10}B with cross sections of 1 to 10 nb. A 6.46 MeV α activity with a half-life of 3.3 ± 0.1 minutes is identified as ^{234}Am. Preparations for studies of γ emission from compound nuclei with high angular momentum and for high energy reaction studies at LAMPF are summarized. Selected sections of this report are listed. (auth)

For titles of individual sections see: 14157 and 14274.

14157 (ORO-3924-14, pp 1-6) LIMITING ANGULAR MOMENTA AND YRAST LINES. 1973.

In angular momentum effects in nuclear reactions.

14158 PERSISTENCE OF THE $^{12}C+^{16}O$–^{28}Si RESONANCE IN THE REACTION $^{13}C(^{16}O, ^{17}O)^{12}C$. Debevec, P.T.; Körner, H.J.; Schiffer, J.P. (Argonne National Laboratory, Argonne, Illinois, 60439). Phys. Rev. Lett. 31: No. 3, 171-173 (16 July 1973).

An anomaly has been seen in the reaction $^{16}O+^{13}C$–$^{17}O+^{12}C$ at a center-of-mass energy of 18.7 MeV. The energy, width, and angular distribution suggest that it is related to a $J^{\pi}=14^{+}$ resonance that has been reported in the $^{16}O+^{12}C$ system. The width and cross section imply a value near the single-particle limit. Possible models for such a resonance are mentioned. (auth)

14159 FAST FORWARD NEUTRON PRODUCTION IN THE $^{7}Li(p,n)^{7}Be$ REACTION FOR 41- AND 64-MeV PROTONS. Wachter, J. W.; Santoro, R. T.; Love, T. A.; Zobel, W. (Oak Ridge National Lab., TN). Nucl. Instrum. Methods; 113: No. 2, 185-187(1973).

Measurements of the neutron energy spectra observed at zero degrees from the $^{7}Li(p,n)^{7}Be$ reaction were made by the time-of-flight technique using 41- and 64-MeV incident protons. The neutron production cross sections for the fast forward peak (corresponding to excitation of the ground and first excited states of ^{7}Be) was found to be 33 ± 6 mb/sr at a mean energy of 39 MeV and 36 ± 4 mb/sr at 60 MeV. These results are compared with those reported elsewhere, and the suitability of such ^{7}Li targets as a source of monoenergetic neutrons is discussed. (2 figures) (auth)

14160 PHOTONUCLEAR REACTION DATA, 1973. Fuller, E. G.; Gerstenberg, H. M.; Vander Molen, H.; Dunn, T. C. National Bureau of Standards Special Publication 380. Washington, DC; National Bureau of Standards (1973). 131p. GPO $1.75.

A brief summary is given of the available data on the gross features of the photonuclear giant resonance. Data are presented in tabular form for all nuclei where measurements have been made. In addition, a comprehensive, annotated data index and bibliography are given which cover experimental data for the field of photonuclear reactions published in scientific and technical journals in the period from 1955 through 1972. Organized by element and isotope, each entry in the index is for a specific reaction reported in a given reference. Information is given on the type of measurement, excitation energies studied, source type and energies, detector type, and angular ranges covered for each reaction entry. (auth)

14161 $^{6}Li(^{3}He, t)$ REACTION AND THE SOLAR NEUTRINO PUZZLE. Halbert, M.L.; Hensley, D.C.; Bingham, H.G. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). Phys. Rev. C 8: No. 4, 1226-1229 (Oct 1973).

A search for a $^{3}He + ^{3}He$ resonance just above threshold was made by means of the reaction $^{6}Li(^{3}He, t)^{6}Be^{*}$ with 46.3-MeV ^{3}He. No resonance was found; the c.m. cross section is ≤ 1.6 μb/sr at 8.4 ° c.m. This corresponds to an upper limit on the spectroscopic factor for $^{6}Be^{*} \rightarrow ^{3}He + ^{3}He$ of 0.0003 to 0.001, depending on the parameters adopted for a distorted-wave Born-approximation calculation. The maximum possible effect of such a resonance on the production of high-energy solar neutrinos is too small to explain the discrepancy between solar-model predictions and the experimental results of Davis et al. (auth)

14162 ISOSPIN-FORBIDDEN AND ALLOWED $^{16}O(d, \alpha)^{14}N$ REACTION. Jolivette, P.L. (Department of Physics, University of Wisconsin, Madison, Wisconsin 53706). Phys. Rev. C 8: No. 4, 1230-1247 (Oct 1973).

Cross sections are reported for the $^{16}O(d, \alpha)^{14}N$ transitions to the ground and first excited state for 2 MeV ≤ E_d ≤ 14 MeV and 8–18 angles. An S-matrix analysis of the isospin-forbidden reaction to the $^{14}N(2.31\text{-MeV})$ T = 1 state yields level parameters, spins, and parities for a large number of ^{18}F intermediate states. Several of these are analogs of T = 1 levels in ^{18}O. The mechanism for the isospin-forbidden reaction is entirely compound nuclear and for the isospin-allowed transition is predominantly so. The isospin impurity, averaged over 1-MeV intervals, is 3–10% for 10 ≤ $E_x(^{18}F)$ ≤ 20 MeV. Analysis by peak counting indicates that $\Gamma_1/D_J \approx 1$ at E_x = 14 MeV and that the average coherence width increases from ≈ 100 keV at E_x = 14 MeV to ≈ 500 keV at E_x = 20 MeV. (auth)

14163 BETA DECAY OF ^{17}N. Poletti, A.R.; Pronko, J.G. (Lockheed Palo Alto Research Laboratory, Palo Alto, California 94304). Phys. Rev. C 8: No. 4, 1285-1293 (Oct 1973).

The delayed-neutron and γ-ray spectra following the β decay of ^{17}N have been investigated using the β–n time-of-flight method, β–γ coincidences, and neutron spectrometry. The following branchings have been determined for the β decay of ^{17}N to established energy levels in ^{17}O: decay to ground state (1.7 ± 0.5%), 0. 87 MeV (2.9 ± 0.5%), 3.06 MeV (0.54 ± 0.08%), 4.55 MeV (37.9 ± 1.8%), 5.377 MeV (51.1 ± 1.5%), and 5.935 MeV (5.8 ± 0.6%). The latter three states are particle unstable and decay by the emission of neutrons to the ground state of ^{16}O. The energies of these neutron groups as determined by us were, respectively, 0.385 ± 0.004, 1.163 ± 0.014, and 1.675 ± 0.024 MeV. The results are discussed and compared to the theoretical calculations. The measured β–decay strengths are compared to the strengths of corresponding transitions in the β–decay of the mirror nucleus ^{17}Ne. (auth)

14164 MECHANISM OF THE $^{12}C(^{6}Li, d)^{16}O$ REACTION AT $E_{^{6}Li}$ = 19–24 MeV. Balamuth, D.P. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19174). Phys. Rev. C 8: No. 4, 1185-1197 (Oct 1973).

The mechanism of the $^{12}C(^{6}Li, d)^{16}O$ reaction has been studied in the energy range $E_{^{6}Li}$ = 19–24 MeV. For the states at E_x = 6.92 and 7.12 MeV we have (a) measured excitation functions in 200-keV steps where the deuterons were detected at 0 °, and (b) measured d–γ angular correlations at three bombarding energies where the deuterons were also detected at 0 °. The excitation curves are found to be relatively smooth functions of bombarding energy. The angular correlations are similar at all three bombarding energies. The results of the angular-correlation measurements are compared with the predictions of both an α-transfer mechanism (using the distorted-wave Born approximation) and a compound-nucleus mechanism (using the Hauser-Feshbach theory). The observed correlations are not completely consistent with the predictions of either theory. Angular correlations measured at lower energies were found to show strong changes with bombarding energy. (auth)

14165 EXCITATION FUNCTIONS FOR NUCLEAR REACTIONS INDUCED BY HIGH ENERGY PIONS. Das, S. (Univ. of Calcutta); Gupta, B. K.; Biswas, M. M. Nucl. Phys.; B66: 482-492(1973).

A theoretical expression for the total cross section of pion induced reactions of the form (π, π n) and (π, πp) was deduced on the basis of the impulse approximation and one-step knock-out mechanism. In the derivation, both the elastic and inelastic interactions were taken into account. The expression was applied to the reactions $^{12}C(\pi^{-}, \pi^{-}n)\,^{11}C$, $^{12}C(\pi^{+}, \pi^{+}n)\,^{11}C$, $^{19}F(\pi^{-}, \pi^{-}n)\,^{18}F$, $^{40}Ar(\pi^{-}, \pi^{-}p)\,^{39}Cl$, $^{65}Cu(\pi^{-}, \pi^{-}n)\,^{64}Cu$ and $^{181}Ta(\pi^{-}, \pi^{-}n)\,^{180}Ta$ for energies 0.08 – 2.0 GeV. The agreement of the calculated values with the experimental data is found to be good. The first resonance peak in all the cases appears to be shifted towards the lower energy side of the free particle pion-nucleon resonance peak. (auth)

14166 FORWARD DISPERSION RELATIONS FOR COMPOSITE PARTICLE SCATTERING. Fang-Landau, S. R. (Eidgenoessiche Technische Hochschule, Zurich); Locher, M. P. Nucl. Phys.; B66: 210-220(1973).

Forward $\alpha\alpha$ scattering is analysed by dispersion relations for $0 < E_{lab} < 120$ MeV. The strong interaction amplitude is obtained for applying outer Coulomb corrections. After Coulomb corrections the ^{8}Be ground state becomes a bound state slightly below threshold. The contributions from this pole, from two pion exchange and from nuclear structure (anomalous cuts) are discussed quantitatively. (auth)

14167 PRECISION DETERMINATION OF THE STRONG INTERACTION SHIFTS AND WIDTHS OF THE 1s LEVEL IN PIONIC ^{6}Li, ^{7}Li, AND ^{9}Be. Backenstoss, G.; Bergstroem, I.; Egger, J.; Hagelberg, R.; Herrlander, C. J.; Koch, H.; Povel, H. P.; Price, R. H.; Schwitter, A.; Tauscher, L. (CERN, Geneva). Nucl. Phys.; B66: 125-134(1973).

The strong-interaction shifts of the 1s level in pionic ^{6}Li, ^{7}Li, and ^{9}Be were determined with an accuracy of better than 1%. The corresponding widths were determined with an accuracy of better than 6%. Significant deviations from the theory are observed as far as the absolute values as well as the systematics of the isospin dependence are concerned. (auth)

14168 PARTIAL RADIATIVE CAPTURE RATES OF PIONS IN ^{6}Li. Roig, F. (Universidad de Valencia); Pascual, P. Nucl. Phys.; B66: 173-181(1973).

The partial radiative capture rates of pions from the 1s and 2p states by ^{6}Li are calculated using the impulse approximation. The possible configuration mixing of the initial and final nuclear wave functions as well as the distortion of the pion wave function due to the finite size of nucleus and the strong interaction between the pion and the nucleons are taken into account. (auth)

14169 EFFECTS OF NON-ORTHOGONALITY AND VIRTUAL EXCITATIONS IN DIRECT REACTIONS. II. Goldfarb, L. J. B.; Takeuchi, K. (Univ. of Manchester, Eng.). Nucl. Phys.; A218: No. 2, 396-404(1974).

Detailed calculations are made to show that nonorthogonality effects in (d, p) stripping reactions are very small and they extend only over large angles except for targets such as ^{40}Ca or lighter nuclei. For these, the effects are larger, reaching values up to 15% and they cover a wider range of angles. (auth)

14170 BACKGROUND-RESONANCE INTERFERENCE EFFECTS IN KNOCKOUT REACTIONS. Pittel, S.; Austern, N. (Univ. of Pittsburgh). Nucl. Phys.; A218: No. 2, 221-238(1974).

Deep-hole excitations formed in knockout reactions decay rapidly by the ejection of additional nucleons. Coherent background processes that lead to the same final states are discussed. Distorted wave calculations are carried out for the 460-MeV ^{12}C (p, 2p) reaction in the energy region of the $s_{\frac{1}{2}}$ knockout peak. Interesting threshold effects occur as a result of the proximity of the $s_{\frac{1}{2}}$ peak to the threshold for $(p_{\frac{1}{2}})^2$ ejection from ^{12}C. The background processes provide small modifications to the resonance peak; this suggests that high energy knockout reactions can serve as a useful probe of inner shells in nuclei. Complications associated with the exclusion principle in intermediate states are responsible for the principal uncertainties of the analysis. (auth)

14171 DEUTERON STRIPPING TO THE SINGLE PARTICLE STATES OF ^{17}O. Cooper, M. D.; Hornyak, W. F.; Roos, P. G. (Univ. of Maryland, College Park). Nucl. Phys.; A218: No. 2, 249-273(1974).

Angular distributions for deuteron-^{16}O elastic scattering and the ^{16}O(d, p)^{17}O reaction leading to levels with E_x = 0.0, 0.87, and 5.08 MeV were measured at energies of 25.4, 36.0 and 63.2 MeV. The elastic deuteron data were fit with a standard spin one optical model potential to obtain parameters for use in a DWBA analysis of the (d, p) data. The potential found in the search is shown to be consistent with other data taken in the range from 25 to 82 MeV. In addition to this deuteron optical potential, an adiabatic deuteron potential, which includes the effects of deuteron breakup, was used in the DWBA analysis. The neutron form factor was selected independent of the width of any state. The mean square radius, a single particle property, is used to find the well parameters and it determines the width of the single particle state. The spectroscopic factors obtained for the ground and first excited states are between 0.8 and 1.0 and are consistent with a large single particle parentage for these states and lower energy data. The width extracted from the DWBA analysis of the 5.08 MeV unbound state was 20% less than that obtained from elastic neutron scattering to the same state, possibly pointing up some difficulties with DWBA procedures commonly used. The adiabatic deuteron potential yields spectroscopic factors that are energy independent to 20% and gives satisfactory calculated angular distribution shapes for angles less than 40°. The conventional deuteron potential gives less satisfactory calculated shapes with the consequent introduction of some ambiguity in the derived spectroscopic factors. (auth)

14172 FINITE RANGE EFFECTS IN (d,p) STRIPPING REACTIONS USING THE WBP MODEL. CoVan, J. M. Tucson, AZ; Univ. of Arizona (1973). 107p. University Microfilms Order No. 73-30,260.

Thesis (Ph. D.).

An approximate method is developed for including effects of a finite range neutron-proton potential V_{np} in calculations for the weakly bound projectile (WBP) model for stripping reactions. The method is similar to the approximate finite range calculations for the distorted wave Born approximation in its use of an expansion method involving the short range of V_{np}. However the method avoids the difficulties associated with these previous applications. For an appropriate choice of V_{np} the expansion in the WBP amplitude is shown to converge, so that the accuracy of the method is determined by the accuracy of the numerical procedures used. The application of the method requires a simple modification of previous zero range calculations and does not significantly increase the time required for computation. Several central potential forms (square well, Gaussian and Yukawa) consistent with low energy two-nucleon scattering are considered for the neutron-proton interaction. Approximate finite range WBP model calculations are reported for the square well and Gaussian forms and the results are shown to be independent of the potential shape. Calculations are also reported which check the effect of truncating the finite range expansion. Qualitative and quantitative effects were observed by comparing zero range and finite range calculations for (d,p) reactions on the target nuclei ^{16}O, ^{40}Ca and ^{90}Zr for values of l_n ranging from 0 to 3. Qualitative changes of the polarization and vector analyzing power were small and no regular trends were apparent. The differential cross section tended to be reduced slightly at the stripping peak and back angles. The most important quantitative effect shown is on the spectroscopic factor which is extracted from the calculated differential cross section. Spectroscopic factors extracted with zero range and finite range codes are compared. Corrections to the spectroscopic factors for light nuclei can be as large as +25%. (Diss. Abstr. Int., B)

Nuclear Properties and Reactions, 20 ≤ A ≤ 38

Refer also to abstracts 12769, 14154, 14156, 14157, 14165, 14197, 14199, 14204, 14237, 14238, and 14518.

14173 (BNL-18335, pp 237-240) EVIDENCE FOR THE DOMINANCE OF ALPHA PARTICLE REMOVAL IN HIGH ENERGY NUCLEAR REACTIONS. Jackson, H. E. (Argonne National Lab., IL); Meyer-Schuetzmeister, L.; Wangler, T. P.; Redwine, R. P.; Segel, R. E.; Tonn, J.; Schiffer, J. P. 1973.

From conference on nuclear and hypernuclear physics with kaon beams; Upton, New York (2 Jul 1973).

In proceedings of the summer study meeting on nuclear and hypernuclear physics with kaon beams.

Various nuclear reactions are reviewed and evidence is given that multiple alpha knock-out is a major channel when sufficient energy is made available to the nucleus. (JFP)

14174 (CONF-730823-21) FUSION AND FISSION IN THE REACTIONS OF ^{12}C WITH ^{27}Al. Chulick, E. T.; Namboodiri, M. N.; Natowitz, J. B. (Texas Agricultural and Mechanical Univ., College Station (USA)). 1973. 18p. (SM-174-104). Dep. NTIS $3.00.

From 3rd symposium on physics and chemistry of fission; Rochester, New York, USA (13 Aug 1973).

Detector telescopes which include a very thin (1.5 μ to 8.4 μ) front detector were employed to measure elemental yields for nuclei produced in the interaction between ^{12}C projectiles and ^{27}Al target nuclei at energies of 100 and 180 MeV. Fusion cross sections including the cross section for fusion followed by fission, were determined by use of the principle of conservation of charge. The fusion cross section is 1.00 barns at 100 MeV and 1.02 barns at 180 MeV. The sharp cutoff limiting angular momentum for fusion at 100 MeV is 29 ħ. The limiting angular momentum for fusion at 180 MeV is 40 ħ, equal to the limit calculated with the liquid drop model. The measured yield distributions, energy spectra and angular distributions indicate that fission accounts for less than 7% of the fusion cross section at 100 MeV and less than 18% of the fusion cross section at 180 MeV. (auth)

14175 (COO-535-693, pp 22-23) (^{3}He,2n) REACTION CROSS SECTIONS ON SEVERAL LIGHT NUCLEI. Moss, C. E.; Zaidins, C. S. 1 Nov 1973.

In nuclear physics laboratory technical progress report, November 1, 1972–November 1, 1973.

14176 (COO-535-693, pp 30-32) TOTAL CROSS SECTIONS AND EXCITATION FUNCTIONS FOR ^{1}H, ^{2}H, ^{3}He, AND ^{4}He ON TARGETS OF NATURAL Mg, Al, AND Si. Zaidins, C. S. (Univ. of Colorado, Boulder); Frantsvog, D. J.; Wilson, R. L.; Kunselman, A. R. 1 Nov 1973.

In nuclear physics laboratory technical progress report, November 1, 1972–November 1, 1973.

14177 (COO-535-693, pp 33-34) MEASUREMENTS OF GAMMA RAY BRANCHING RATIOS IN ^{28}Al. Moss, C. E. 1 Nov 1973.

In nuclear physics laboratory technical progress report, November 1, 1972–November 1, 1973.

14178 (IKDA-73-6, pp 76-78) EXPERIMENTS WITH THE He JET ON ^{30}Na. Torgerson, D. F.; Wien, K.; Macfarlane, R. D.; Fares, Y. Jul 1973. (In German).

Thesis. Submitted by K. Wien to Texas A and M Univ., College Station (USA).

In progress report, 1971–1972.

14179 STATES AT HIGH EXCITATION ENERGIES IN ^{24}Mg OBTAINED FROM Li-INDUCED REACTIONS ON ^{20}Ne. Lepareux, M. (CEN, Saclay, France); Saunier, N.; Gerardin, C.; Wery, M.; Foti, A.; Pappalardo, G.; Strazzeri, A. Lett. Nuovo Cim.; 8: No. 12, 725-728(17 Nov 1973).

Deuteron and triton energy spectra were measured in the α-particle transfer reactions ^{20}Ne(^{6}Li,d)^{24}Mg and ^{20}Ne(^{7}Li,t)^{24}Mg at ^{7}Li energies of 29.6 MeV and ^{6}Li energies of 29.6 MeV and 25.6 MeV. Strongly populated states were apparent in all spectra from an excitation energy of 8 MeV up to about 25 MeV. Comparisons are made with other data. It is noted that the strongly populated levels in the energy region corresponding to an α-transfer into the empty f-p orbit corresponding to the quartet configurations [311] and [221]. (LBS)

14180 RECOIL IN (^{16}O, ^{15}N) REACTIONS ON 2s-1d- AND 1f-2p-SHELL NUCLEI. DeVries, R.M. (Department of Physics, University of Washington, Seattle, Washington 98195). Phys. Rev. C 8: No. 4, 1542-1544 (Oct 1973).

The recently published data and nonrecoil distorted-wave Born-approximation (DWBA) calculations of Maher et al. are compared with exact recoil DWBA predictions to study quantitatively recoil effects on single-nucleon-transfer heavy-ion reactions on medium-mass targets at energies ~10 MeV above the Coulomb barrier. (auth)

14181 MASS AND β DECAY OF THE NEW ISOTOPE ^{29}Mg: SYSTEMATICS OF MASSES OF $T_z = 5/2$ NUCLIDES IN THE 2s-1d SHELL. Goosman, D.R. (Brookhaven National Laboratory, Upton, New York 11973); Davids, C.N.; Alburger, D.E. Phys. Rev. C 8: No. 4, 1331-1338 (Oct 1973).

Measurements of the mass, half-life, and β decay of the new isotope ^{29}Mg are reported. Produced by the ^{18}O(^{13}C,2p)^{29}Mg reaction, this activity was periodically transferred to remotely located Ge(Li) and NE 102 detectors. γ-ray energies (in keV) and relative intensities for the ^{29}Al daughter transitions are 960.3 $\pm$ 0.4 (52 $\pm$ 18), 1397.7 $\pm$ 0.4 (64 $^{+30}_{-20}$), 1430 $\pm$ 1.5 (34 $\pm$ 17), 1753.8 $\pm$ 0.4 (22 $\pm$ 5), and 2223.7 $\pm$ 0.4 (100 $\pm$ 6). The ^{29}Al excitation energies (in keV) and relative β branching intensities are 1397.7 $\pm$ 0.4 (64^{+35}_{-28}), 1753.8 $\pm$ 0.4 (< 10), 2223.8 $\pm$ 0.4 (555 $\pm$ 22), and 3184.0 $\pm$ 0.6 (100 $\pm$ 35). Upper limits on other possible transitions are given. ^{29}Mg decays with a half-life of 1.20 $\pm$ 0.13 sec, measured by the decay of the prominent 2224-keV γ ray. The decay of ^{29}Mg is discussed in terms of the Nilsson model. By measuring the spectrum of pulses in the NE 102 detector coincident with 2224-keV γ rays, the mass excess for ^{29}Mg has been determined to be -10590 $\pm$ 400 keV, disagreeing by 1.7 $\pm$ 0.5 Mev from a previous report. The present mass for ^{29}Mg is combined with all other information concerning masses of $T_z = 5/2$ nuclides in the 2s-1d shell, and the results are compared with predictions based upon measured masses closer to stability using the transverse relationship of Garvey. When the differences between the measured and predicted values are plotted against atomic weight, systematic effects are evident. (auth)

14182 LIFETIMES OF THE LOWEST 5/2$^+$ AND 9/2$^+$ STATES OF THE MIRROR PAIR ^{23}Na-^{23}Mg. Warburton, E.K.; Kolata, J.J.; Olness, J.W. (Brookhaven National Laboratory, Upton, New York 11973). Phys. Rev. C 8: No. 4, 1385-1390 (Oct 1973).

The lifetimes of the 5/2$^+$ and 9/2$^+$ members of the $K^\pi = 3/2^+$ ground-state rotational band in the mirror pair ^{23}Na-^{23}Mg have been measured via the Doppler-shift attenuation method. The reactions ^{12}C + ^{12}C = ^{23}Na + p or ^{23}Mg + n were used and line shapes of the decay γ rays were observed in singles for recoil into Al and Ni backings. The results are 1.63$\pm$0.20 and 2.00$\pm$0.24 psec for the ^{23}Na and ^{23}Mg 5/2$^+$ first excited states and 0.11$\pm$0.02 and 0.08$\pm$0.02 psec for the ^{23}Na and ^{23}Mg 9/2$^+$ states. These results are compared to the predictions of the Nilsson model. The separation of the isoscalar and isotensor components of the M1 rates is discussed as well as the separation of the spin and orbital contributions to the isotensor component. Incidental to this work, the energies of the first excited states were determined as 439.80$\pm$0.15 keV (^{23}Na) and 450.70$\pm$0.15 keV (^{23}Mg), and the 9/2$^+$-7/2$^+$ transition energies were measured with comparable accuracy. (auth)

14183 SPIN AND PARITY OF ^{20}F LEVELS FROM GAMMA-RAY LINEAR-POLARIZATION MEASUREMENTS. Longo, D.S.; Lawson, J.C.; Alexander, L.A.; Hichwa, B.P.; Chagnon, P.R. (Department of Physics, University of Notre Dame, Notre Dame, Indiana 46556). Phys. Rev. C 8: No. 4, 1347-1353 (Oct 1973).

The status of experimental quantum number assignments to low-lying levels of ^{20}F is reviewed. The use of a Compton-scattering polarimeter of limited resolution but good efficiency, in coincidence with an annular particle detector and perpendicular to the reaction symmetry axis, is described. Measurements of ^{20}F* deexcitation γ-ray polarization have been carried out following the ^{18}O(^{3}He, p) reaction at 3.8 MeV and 0°. In conjunction with past experiments, the following assignments are inferred: 656 keV, 3$^+$; 823 keV, 4$^+$; 984 keV, 1$^-$; 1309 keV, 2$^-$; 1824 keV, 5$^+$; and 1843 keV, (2$^-$). The relation of the experimental level structure to the rotational band grouping and to the pds shell-model calculation of McGrory and and Wildenthal is illustrated. (auth)

14184 ACCURATE MASSES AND β-DECAY SCHEMES FOR ^{34}P AND ^{33}Si. Goosman, D.R. (Brookhaven National Laboratory, Upton, New York, 11973); Davids, C.N.; Alburger, D.E. Phys. Rev. C 8: No. 4, 1324-1330 (Oct 1973).

By using delayed β-γ coincidence techniques, the mass excesses of ^{34}P and ^{33}Si have been measured to be -24546 $\pm$ 45 and -20569 $\pm$ 50 keV, respectively, representing improvements in precision of the factor of 2 for ^{34}P and a factor of 4 for ^{33}Si over previous measurements. The first measurements of the high-energy γ rays from ^{34}P decay with a Ge(Li) detector are presented, revealing three new β branches. γ-ray energies (in keV) and relative intensities for the ^{34}S daughter transitions are 1787 $\pm$ 1 (0.30 $\pm$ 0.10), 1947.1 $\pm$ 1.5 (0.28 $\pm$ 0.10), 1987.2 $\pm$ 1.0 (1.0 $\pm$ 0.2), 2127.4 (100.0 $\pm$ 0.3), 4073.4 $\pm$ 1.5 (0.46 $\pm$ 0.06), and 4114.0 $\pm$ 1.5 (1.2 $\pm$ 0.2). The ^{34}S excitation energies and relative β branches are 2117.4 (100 $\pm$ 0.3), 3303.7 (< 0.26), 3914.2 (0.30 $\pm$ 0.10), 4073.0 (0.76 $\pm$ 0.12), and 4114.5 (2.2 $\pm$ 0.3). For the decay of ^{33}Si, energies and relative intensities of γ rays were measured to be 415.8 $\pm$ 0.6 (6.7 $\pm$ 0.6), 1431.4 (13.1 $\pm$ 1.0), 1847.5 (100 $\pm$ 1), and 2537.5 (9.3 $\pm$ 0.8), representing excitation energies and relative β-ray intensities to the ^{33}P daughter states of 1431.4 (5.1 $^{+1.0}_{-2.4}$), 1847.5 (100 $^{+1.0}_{-2.8}$), and 2537.6 (10.5 $\pm$ 1.0). The half-lives of ^{34}P and ^{33}Si were determined by multiscaling γ-ray yields to be 12.45 $\pm$ 0.10 and 6.11 $\pm$ 0.21 sec, respectively. Combined with an earlier result, a half-life of 6.18 $\pm$ 0.18 sec is adopted for ^{33}Si. The transverse mass relationship of Garvey, using the present measurements for ^{34}P and ^{33}Si, predicts a mass excess of -20251 $\pm$ 90 keV for the $T_z = 3$ nuclide ^{34}Si. (auth)

14185 COMPOUND-NUCLEUS AND DEUTERON D-STATE EFFECTS OBSERVED IN THE T_{20} ANALYZING POWER OF (d, p) REACTIONS. Meyer, H.O.; Thomson, J.A. (University of Wisconsin, Madison, Wisconsin 53706). Phys. Rev. C 8: No. 4, 1215-1221 (Oct 1973).

The tensor-analyzing power T_{20} of (d, p) reactions on ^{12}C, ^{28}Si, and ^{40}Ca are measured at small angles as a function of bombarding energy. Measurements are carried out for θ_{lab} from 0-15° and E_d from 5-12 MeV. Strong fluctuations of T_{20} with energy are observed. The measurements are not explained by distorted-wave calculations which neglect the deuteron D state. Inclusion of the D state leads to better agreement with the data. The remaining discrepancy between the D-state calculation and the measured T_{20} can be explained by a compound-nucleus contribution to the reaction mechanism. (auth)

14186 CROSS SECTIONS OF (n,p) AND (n,α) REACTIONS AT THE NEUTRON ENERGY OF 14 TO 15 MeV. Levkovskii, V. N. (Inst. of Nuclear Physics, Alma-Ata, USSR). Yadern. Fiz.; 18: No. 4, 705-709(Oct 1973). (In Russian).

All the data on the (n,p) and (n,α) reaction cross sections available in literature (up to 1972) are critically analysed. The most confident averaged values of the cross sections σ are presented. It is shown that for targets with $Z \geq 20$ the emission probabilities for protons and α particles ($\alpha_x = \sigma_{nx}/\sigma_{inel}$) depend in a simple way on the "asymmetry factors" (N-Z)/A, while in most of the cases α_p is about 2.5 as much as α_α. No "shell effects" are observed, as well as no Q dependence in the reactions. Coulomb barriers and level densities of the final nuclei are determined. An assumption is quoted that the observed regularities reflect approximately the "equilibrium" relations between probabilities of emission of the "first" particle by the highly excited intermediate nucleus. (auth)

14187 POLARIZATION OF SPIN-½ PARTICLES IN DIFFRACTION THEORY OF SCATTERING. Pucherov, N. N.; Romanovskii, S. V.; Chesnokova, T. D. (Inst. of Nuclear Research, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 18: No. 10, 1717-1723(Oct 1973). (In Russian).

The basic features of polarization of protons in elastic scattering by nuclei are shown to be described satisfactorily as a function of energy and angle in terms of the diffraction theory. (auth)

14188 ELECTRON SCATTERING BY 2s-1d-SHELL NUCLEI IN THE α-PARTICLE MODEL. Antonov, A. N.; Inopin, E. V. (Kharkov State Univ.). Ukr. Fiz. Zh. (Russ. Ed.); 18: No. 10, 1585-1590(Oct 1973). (In Russian).

Elastic and inelastic scattering of high energy electrons by the 2s-1d-shell nuclei is studied on the basis of a version of the α-particle model which considers connection with the shell-model. The 2s-1d-shell nuclei are considered as an inert core of ^{16}O with an α-particle system above the core. The calculated values of the proposed model are in good agreement with the experimental data obtained from electron scattering by the ^{20}Ne, ^{24}Mg, ^{28}Si and ^{32}S nuclei. (auth)

14189 ^{35}Cl(p, γ)^{36}Ar REACTION AND THE ENERGY LEVELS OF ^{36}Ar. Johnson, P. M.; Meyer, M. A.; Reitmann, D. (Potchef-

stroom Univ., South Africa). Nucl. Phys.; A218: No. 2, 333-354 (1974).

Proton energies and strengths of (p, γ) and (p, p_1) resonances of the ^{35}Cl + p reaction were determined for E_p = 0.4 to 3.0 MeV and 1.9 to 3.0 MeV, respectively. The γ-decay of 84 resonances was studied with a 40 cm^3 Ge(Li) detector. The branching ratios and excitation energies of 38 bound levels were determined. A new bound level was observed at E_x = 8472.0 ± 1.0 keV. Doppler-shift attenuation experiments yielded lifetimes of 20 bound levels. Spins and/or parities for bound levels and resonances were derived on the basis of observed transition strengths. (auth)

14190 RECOIL DISTANCE LIFETIME MEASUREMENTS IN ^{26}Mg AND ^{26}Al. Berant, Z.; Broude, C.; Engler, G.; Renan, M. J. (Weizmann Inst. of Science, Rehovot, Israel). Nucl. Phys.; A218: No. 2, 324-332(1974).

Levels in ^{26}Mg and ^{26}Al were excited with the ^{23}Na + α reaction, and the recoil-distance method was used to determine the mean lives of the following levels: ^{26}Mg, 3.59 MeV (9.6 ± 1.2 ps) and 3.94 MeV (1.38 ± 0.11 ps); ^{26}Al, 1.76 MeV (6.4 ± 0.4 ps) and 2.072 MeV (1.00 ± 0.10 ps). The deduced values are compared to previous measurements by the Doppler-shift attenuation method. (auth)

14191 EFFECT OF CORE EXCITATIONS ON ^{29}Si AND ON THE GIANT DIPOLE RESONANCE IN ^{28}Si. Johnstone, I. P.; Castel, B. (Queen's Univ., Kingston, Ont.). Can. J. Phys.; 51: No. 9, 988-992(1 May 1973).

The structure of ^{29}Si is studied in a model which couples a neutron onto low-lying core states of ^{28}Si. Very satisfactory agreement is obtained for energy levels, E2 transition rates, and spectroscopic factors. The splitting of the ^{28}Si dipole strength is then investigated using a particle-core and hole-core interaction derived from this ^{29}Si study, and the effect of various approximations is examined. (auth)

14192 MEAN LIFETIME OF THE 1612 keV LEVEL IN ^{37}Ar. Verucchi, M. J.; Vaillancourt, R.; Cardinal, C.; Taras, P. (Univ. of Montreal). Can. J. Phys.; 51: No. 10, 1039-1041 (15 May 1973).

The recoil-distance method was used to measure the mean lifetime of the $J^\pi = 1/2^-$, 1612 keV level in ^{37}Ar. The level was populated via the ^{34}S(α,n)^{37}Ar reaction at E_α = 7.9 MeV. The mean lifetime was found to be 6.47 ± 0.22ns. (auth)

14193 EXAMINATION OF THE HARMONIC OSCILLATOR APPROXIMATION IN THE NILSSON MODEL. Hird, B.; Huang, K. H. (Univ. of Ottawa). Can. J. Phys.; 51: No. 9, 956-967 (1 May 1973).

The major shell mixed Nilsson model which includes hexadecapole deformations predicts states from the $1g_{\frac{9}{2}}$ subshell in the low lying energy level spectra of ^{25}Mg–^{25}Al in a way which is not found experimentally. The ground state spin cannot be explained with this model for reasonable values of the deformation. These difficulties are removed when a Saxon–Woods function is used for the radial dependence of the one body potential. A good fit to the experimental levels is then produced for accepted deformations, but only if the RPC terms are considerably reduced. (auth)

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Refer also to abstracts 14146, 14154, 14169, 14172, 14173, 14180, 14185–14187, 14215, 14217, 14220, 14228, 14233, 14237, 14238, 14297, 14306, 14310, and 14312.

14194 (COO-535-693, pp 14-17) STUDY OF THE HELION OPTICAL POTENTIAL AMBIGUITIES FOR ^{40}Ca AND ^{58}Ni. Chang, H. H. (Univ. of Colorado, Boulder); Ridley, B. W.; King, N. S. P.; Gibson, E. F. 1 Nov 1973.

In nuclear physics laboratory technical progress report, November 1, 1972–November 1, 1973.

14195 (COO-535-693, pp 17-20) ^{40}Ca(α,α) AND ^{58}Ni(α,α) AT 82.0 AND 85.6 MeV. Chang, H. H. (Univ. of Colorado, Boulder); Ridley, B. W.; King, N. S. P.; Gibson, E. F. 1 Nov 1973.

In nuclear physics laboratory technical progress report, November 1, 1972–November 1, 1973.

14196 (COO-535-693, pp 48-50) ANTI-ANALOG STATE TRANSITION ^{56}Fe(p,n)^{56}Co(0$^+$ AAS). Rickertsen, L. D.; Fielding, H. 1 Nov 1973.

In nuclear physics laboratory technical progress report, November 1, 1972–November 1, 1973.

14197 (COO-535-693, pp 51-53) THICK TARGET MEASUREMENT OF STELLAR REACTION RATES. Roughton, N. A.; Fritts, M. J.; Peterson, R. J.; Hansen, C. J.; Zaldins, C. S. 1 Nov 1973.

In nuclear physics laboratory technical progress report, November 1, 1972–November 1, 1973.

14198 (COO-535-693, pp 110-114) EFFECTIVE DEUTERON OPTICAL POTENTIAL IN (p,d;d,n) PROCESSES. Rickertsen, L. D. 1 Nov 1973.

In nuclear physics laboratory technical progress report, November 1, 1972–November 1, 1973.

14199 (COO-3001-51) T = 1 TO T = 0 SPLITTING OF THE $f_{\frac{5}{2}}d_{\frac{5}{2}}^{-1}$ PARTICLE-HOLE MULTIPLET. Osnes, E.; Kuo, T. T. S. (Oslo Univ. (Norway). Fysisk Institutt; State Univ. of New York, Stony Brook (USA). Dept. of Physics). 1971. Contract AT(11-1)-3001. 11p. Dep. NTIS $3.00.

The T = 1 to T = 0 splitting of the $f_{\frac{5}{2}}d_{\frac{5}{2}}^{-1}$ particle-hole multiplet shows a J-dependence which is well reproduced by the Kuo-Brown interaction. The calculated average magnitude of the splitting is too small by a factor of two using the bare particle-hole interaction, but is increased to 80% of the experimental value including the second-order corrections. Results are also given for selected phenomenological and empirical interactions. (auth)

14200 (IAEA-153, pp 421-445) FAST NEUTRON CROSS SECTIONS OF ELEMENTAL TITANIUM: MICROSCOPIC MEASUREMENT AND INTERPRETATION. Barnard, E. (Atomic Energy Board, Pelindaba, S. Afr.); de Villiers, J. A. M.; Reitmann, D.; Smith, A. B.; Pennington, E. M.; Whalen, J. F. 1973.

From proceedings of a panel on neutron nuclear data evaluation; Vienna, Austria (30 Aug 1971).

Neutron total and elastic- and inelastic-scattering cross sections of natural titanium were measured. Total cross sections were determined over the interval 0.1 to 1.5 MeV with resolutions of ≳ 1.5 keV. Differential elastic and inelastic neutron scattering angular distributions were measured from 0.3 to 1.5 MeV with resolutions of ≳ 5 keV. The cross sections for the inelastic neutron excitation of states in ^{46}Ti (899.2 keV), ^{48}Ti (983.5 keV), and ^{47}Ti (159.6 keV) were determined. The energy-averaged behavior of the measured results was described in terms of optical and statistical models. (7 figures, 1 table) (auth)

14201 (IKDA-73-6, pp 49-54) MUON CAPTURE IN NUCLEI. Jul 1973. (In German).

In progress report, 1971–1972.

14202 (JINR-P4-7263) TWO-STAGE EFFECTS IN DEUTERON STRIPPING REACTIONS ON SPHERICAL NUCLEI. Luk'yanov, V. K.; Semenov, V. M.; Tseipek, Ya. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 26p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.50.

A concept is developed mathematically which provides a simple physical explanation for two-stage processes in neutron transfer. Two-stage processes are basic in considering cross sections regarded as forbidden in one-stage transfers. In their contribution to interference phenomena (polarization, asymmetry, J dependence of cross sections), two-stage effects are as important as those usually used for describing these values of spin-orbital forces in d- and p-paths of reaction. (tr-auth)

14203 POSSIBLE L-DEPENDENT ANGULAR DISTRIBUTIONS IN THE REACTION ^{48}Ca(^{14}N, ^{13}C)^{49}Sc. Schneider, M.J.; Chasman, C.; Auerbach, E.H.; Baltz, A.J.; Kahana, S. (Brookhaven National Laboratory, Upton, New York, 11973). Phys. Rev. Lett. 31: No. 5, 320-323 (30 July 1973).

The reaction ^{48}Ca(^{14}N, ^{13}C)^{49}Sc has been investigated at 50 MeV using a magnetic spectrometer. Angular distributions were extracted for 16 levels below 5.8 MeV excitation. The relative yields of levels were found to be similar to (^{3}He,d). The ground-state angular distribution (transferred L=4) peaked at the most forward angle observed (9° c.m.), but the yields of other strong levels (L ≤ 2) did not. This apparent L-dependence was reproduced by no-recoil distorted-wave Born-approximation calculations using weakly absorbing potentials. (auth)

14204 PROPERTIES OF SOME HIGH SPIN STATES IN ^{41}Ca. Bizzeti, P. G.; Bizzeti-Sona, A. M.; Mando, P. A. (Technische Univ., Munich). Lett. Nuovo Cim.; 8: No. 13, 783-786(24 Nov 1973).

The level scheme of ^{41}Ca was investigated with the reactions ^{40}Ca (^{3}He, 2p) ^{41}Ca at 14.5 and 18 MeV and ^{39}K (^{7}Li,αn) ^{41}Ca at 20 MeV, measuring the γ-γ coincidence for both reactions and the lifetimes of some excited levels for the first reaction. In addition to the known levels, a new level is found at 5220 keV from the ^{7}Li reaction. Some definite limits for the spin of the different levels are established. (LBS)

14205 COLLECTIVE POTENTIAL-ENERGY SURFACES AND COLLECTIVE BEHAVIOR OF ^{46,48,50}Ti. Rebel, H (Zyklotron-Laboratorium des Kernforschungszentrum Karlsruhe, Karlsruhe, Germany); Habs, D. Phys. Rev. C 8: No. 4, 1391-1393 (Oct 1973).

On the basis of the generalized collective model of Greiner and Gneuss the collective potential-energy surfaces of ^{46,48,50}Ti are determined by fitting level schemes and B(E2;$0^+ \rightarrow 2^+$) values. Though successful for ^{48,50}Ti, the model which is restricted to quadrupole deformations, is not able to reproduce the relatively low E_{4^+}/E_{2^+} ratio of 1.72 for ^{50}Ti. (auth)

14206 ^{51}V(^{3}He, d)^{52}Cr REACTION AND SHELL-MODEL CALCULATIONS FOR ^{52}Cr. Pellegrini, F. (Istituto di Fisica dell'Università, Padova, Italy); Filosofo, I.; El Zaiki, M.I.; Gabrielli, I. Phys. Rev. C 8: No. 4, 1547-1551 (Oct 1973).

Angular distributions of the (^{3}He, d) reaction on ^{51}V have been measured at 10.48 MeV with a counter telescope. Spectroscopic factors and l values of ^{52}Cr levels up to 7 MeV excitation energy were obtained by comparing the data with distorted-wave Born-approximation theory. Some unreported levels excited by l = 1 proton transfer have been observed. Shell-model calculations predict well the $1f_{(7/2)}$ spectroscopic strength, but fail in reproducing the observed $2p_{(3/2)}$ strength. (auth)

14207 TRANSITION RATES IN ^{44}Ca. McCullen, J.D.; Donahue, D.J. (Department of Physics, University of Arizona, Tucson, Arizona 85721). Phys. Rev. C 8: No. 4, 1406-1412 (Oct 1973).

The mean lives of states in ^{44}Ca up to an excitation energy of 3360 keV have been measured by the Doppler-shift attenuation method, using both solid and gas backings to slow the recoiling nuclei. Most of the states have lifetimes in the range of a few picoseconds, a "time region" at the limit of sensitivity of either method alone. The combination of the two methods gives accurate upper and lower limits, and a value for the mean life. The resulting experimental transition probabilities are compared to a calculation which assumes the existence of a core-excited rotational band in ^{44}Ca identical to that found to be necessary in ^{42}Ca. A general agreement is obtained. A value has also been measured for the mean life of the 2750-keV 4^+ state in ^{42}Ca. (auth)

14208 RADIATIVE CAPTURE OF s ELECTRONS IN THE DECAY OF ^{51}Cr. Mutterer, M. (Central Bureau for Nuclear Measurements, EURATOM, 2440 Geel, Belgium). Phys. Rev. C 8: No. 4, 1370-1378 (Oct 1973).

The high-energy portion of the spectrum of internal-bremsstrahlung photons accompanying the allowed electron-capture transition from ^{51}Cr to the ground state of ^{51}V has been measured with a Ge(Li) γ-ray spectrometer supplied with a pileup rejector. The most important correction for the residual pileup spectrum caused by the 320.1-keV nuclear γ rays from the deexcitation of the first excited state in ^{51}V was performed by extrapolation from a set of measurements with sources of different activities. The pulse-height spectrum of internal-bremsstrahlung photons was corrected for detector response. For energies higher than 348.1 keV the number of bremsstrahlung photons emitted per ground-state electron-capture (EC) decay of ^{51}Cr was determined to be $(9.56 \pm 0.60) \times 10^{-5}$. Corresponding theoretical values are 9.49×10^{-5} predicted by the theory of Martin and Glauber, and 9.47×10^{-5} deduced from recent calculations of Intemann. The present result confirms the predictions of theory for radiative capture of 1s + 2s orbital electrons, in contradiction to recent results on ^{51}Cr and other EC decaying light nuclides, obtained mainly by bremsstrahlung-γ-coincidence measurements. The transition energy of ^{51}Cr was determined to be 760 $\pm$ 15 keV, in good agreement with accepted atomic mass differences. (auth)

14209 SMALL-ANGLE INELASTIC SCATTERING OF 40 MeV PROTONS BY ^{12}C, ^{40}Ca, ^{56}Fe, AND ^{58}Ni. Ingham, D. (Univ. of California, Santa Barbara); Eisberg, R.; Makino, M.; Waddell, C. Nucl. Instrum. Methods; 114: No. 1, 5-12(1974).

Angular distributions were measured for inelastic scattering of 40-MeV protons to several states of ^{12}C, ^{40}Ca, ^{56}Fe, and ^{58}Ni in the angular range of 4 to 20°. In a special small-angle scattering chamber, the inelastic protons were detected with a telescope consisting of three passing-geometry 3-mm Si(Li) detectors. Spurious events, produced when some of the very numerous elastic protons bombarding the detector produce nuclear reactions in it, were eliminated in a computer analysis. The experimental results are compared with DWBA and coupled-channel calculations, and with McCarthy's parity rule. (4 figures) (auth)

14210 HARTREE-FOCK AND SHELL-MODEL STUDIES OF ^{56}Ni. Dang, G.; Rabbat, J. A. (Laboratoire de Physics, Orsay, France). Can. J. Phys.; 51: No. 7, 737-742(1 Apr 1973).

The structure of the low-lying states of ^{56}Ni is studied in the frameworks of the Hartree-Fock theory and the shell model. Attention is focused on the choice of the single particle energies and the effect of highly excited states. It is found that the low-lying states can reasonably be described by the shell model with 1p-1h and 2p-2h excitations from the $1f_{\frac{7}{2}}$ level. A critical discussion of the contradictory results of previous works is made and their connection with the present work is pointed out. (auth)

14211 ^{40}Ca(p,2p)^{39}K REACTION AT 45.0 MeV. Bray, K. H.; Bunker, S. N.; Jain, M.; Jayaraman, K. S.; Miller, C. A.; Nelson, J. M.; Van Oers, W. T. H.; Wells, D. O. (Univ. of Manitoba, Winnipeg). Can. J. Phys.; 51: No. 9, 1012-1016(1 May 1973).

A study of the ^{40}Ca(p,2p)^{39}K reaction was made for two states of ^{39}K, the $1d^{-1}_{\frac{3}{2}}$(g.s.) and $2s^{-1}_{\frac{1}{2}}$(2.53 MeV). Angular correlations at symmetric, coplanar angles between 30 and 105° were measured. The data are compared with a distorted wave t-matrix calculation which utilizes a nonlocal bound state wave function. A further comparison is made with the angular correlation for unequal energies of the final state protons. (auth)

14212 NUCLEAR g FACTORS IN ^{55}Fe. Kerr, P. G.; Gibb, A. W.; Cameron, J. A. (McMaster Univ., Hamilton, Ont.). Can. J. Phys.; 51: No. 7, 707-712(1 Apr 1973).

The (α,n) reaction on natural chromium was used to study levels in ^{55}Fe up to 2.5 MeV excitation. Intensities and angular distributions of the decay gamma rays were measured, yielding branching and E2/M1 mixing ratios. In a magnetized target of the alloy $Cr_{30}Fe_{80}$, the rotation of the angular distributions was observed. Using recently determined lifetimes for the excited states and the average internal field of 277 kOe measured in the target material by Mossbauer absorption, the following g factors are obtained: 931 keV, $\frac{5}{2}^-$: +1.2 ± 0.5, 1316 keV, $\frac{7}{2}^-$: +0.5 ± 0.5, and 1408 keV, $\frac{7}{2}^-$: −0.77 ± 0.16. (auth)

14213 DETERMINATION OF THE ACTIVATION CROSS SECTION σ_{therm} AND OF THE HALF-LIFE OF ^{53}Mn BY A REACTOR IRRADIATION OF 587 DAYS. Woelfle, R. (Kernforschungsanlage, Juelich, Ger.); Herr, W.; Herpers, U. Radiochim. Acta; 18: No. 4, 207-211(1973).

The determination of the halflife of long-lived ^{53}Mn is performed by measuring the activation cross section σ_{therm}. This spallogenic nuclide has recently gained great interest because of the cosmochemical importance. For this purpose meteoritic ^{53}Mn was partially transmuted by an intense long term neutron irradiation over ^{54}Mn to ^{54}Cr. From the difference in the ^{54}Mn production rate at the start and at the end of the irradiation the activation cross section $\sigma_{53} = 66 \pm 7$ barn is calculated. The redetermination of the product $T_{53} \times \sigma_{53} = (260 \pm 32)$ barn × years results in a halflife of $T_{53} = (3.9 \pm 0.6) \times 10^6$ years. The influence of the diverse parameters and the limits of error are discussed in some detail. (orig.) (GE)

14214 NEUTRON CORRELATIONS IN THE ^{41}K GROUND STATE AND TWO PARTICLE-TWO HOLE STATES IN ^{40}K. Williams, M. E. New Brunswick, NJ; Rutgers-The State Univ. (1973). 173p. University Microfilms Order No. 73-27,995.

Thesis (Ph. D.).

Differential cross sections were measured for ^{41}K-(p,d)^{40}K and ^{41}K(d,t)^{40}K using 15 MeV proton and deuteron beams from the Rutgers-Bell Tandem Van de Graaff Accelerator. Reaction products were detected by proportional counterscintillator telescope or semiconductor detector in an Enge split-pole spectrograph. Only four states (the negative parity quadruplet below 1 MeV excitation in ^{40}K) are observed in the ^{41}K(p,d)^{40}K reaction. Six positive parity (presumably T = 1 two particle-two hole states) and seven negative parity states (one particle-one hole states) below 2.7 MeV excitation in ^{40}K were studied using the ^{41}K(d,t)^{40}K reaction. Distorted wave Born approximation (DWBA) calculations using published proton, deuteron and triton parameters were performed, and cross sections fitted with incoherent mixtures of f- and p-wave shapes (negative parity states) or s- and d-wave shapes (positive parity states). Empirical pure f-wave shapes were used to fit (d,t) cross sections. Knowledge of the structure of ^{40}K multiplets ($\nu f_{\frac{7}{2}}$, $\pi d^{-1}_{\frac{3}{2}}$) and ($\nu p_{\frac{3}{2}}$, $\pi d^{-1}_{\frac{3}{2}}$) permits determination of wave function amplitudes and relative phases for various configurations and neutron correlations in the ^{41}K ground state. Spectroscopic factors for neutron pickup to states in ^{40}K are strongly influenced by the interference of transition amplitudes. The ^{41}K wave function amplitudes and relative phases extracted from spectroscopic factor information are compared with theoretical predictions. Spectroscopic factors for two-particle two-hole states observed in the ^{41}K(d,t)^{40}K reaction are interpreted on the basis of the ^{41}K ground state wave function and predictions of the structure of the states in ^{40}K. (Diss. Abstr. Int., B)

Nuclear Properties and Reactions, 59 ≤ A ≤ 89

Refer also to abstracts 14153, 14154, 14186, 14187, 14205, 14233, 14235, 14237–14239, 14269, and 14295.

14215 (BNL-tr-545) INELASTIC SCATTERING OF FAST NEUTRONS BY Cr, Ni, Y, Zr, AND W NUCLEI. Sal'nikov, O. A.; Lovchikova, G. N.; Kotel'nikova, G. V.; Fetisov, N. I.; Trufanov, A. M. (Brookhaven National Lab., Upton, N.Y. (USA)). Jul 1973. Translation by S. J. Amoretty of IAEA-CN-26/79. 30p. Dep. NTIS $3.50.

A study is made of the neutron spectra emitted by Cr, Ni, Y, Zr, and W nuclei following bombardment with 14.4-MeV neutrons and of the differential cross sections of the (n,n'), (n,2n), and (n,pn) reactions for these nuclei are reported. The differential cross sections and spectra were measured at angles ranging from 30 to 150° and 30° intervals. (JFP)

14216 (COO-535-693, pp 24-25) LEVEL STRUCTURE OF ^{88}Y AND ^{90}Y FROM A STUDY OF THE (α,nγ) REACTION. Bunting, R. L.; Kraushaar, J. J. 1 Nov 1973.

In nuclear physics laboratory technical progress report, November 1, 1972–November 1, 1973.

14217 (IKDA-73-6, pp 63-66) STUDY OF PARITY VIOLATION IN NUCLEAR STATES. Dewes, P.; Kankeleit, E.; Kuphal, E.; Scherg, W. Jul 1973. (In German).

In progress report, 1971–1972.

14218 INTENSITIES OF THE 2158- AND 2505-keV GAMMA RAYS IN THE DECAY OF COBALT-60. Fujishiro, M. (Radiation Centre of Osaka Prefecture, Sakai, Japan). Nucl. Sci. Eng.; 52: No. 4, 474-481(Dec 1973).

The intensities of the weak 2158- and 2505-keV gamma rays following the β^- decay of ^{60}Co were measured by applying the photonuclear reactions ^{9}Be(γ,n) and ^{2}D(γ,n). The results obtained were I(2158) = $(2.0 \pm 1.3) \times 10^{-5}$ and I(2505) = $(0.9 \pm 0.7) \times 10^{-7}$ photons per decay of ^{60}Co. The present result for I(2158) agrees with other data found in the literature within stated errors, whereas that for I(2505) is significantly smaller than previous estimates. From the present value of I(2158), the rate, B_2, and logarithmic comparative half-life, log f_2t_2, of the second-forbidden unique β^- decay, which is intimately related to this intensity, were estimated as $B_2 \leq (15.0 \pm 9.8) \times 10^{-3}$% and log $f_2t_2 \geq 10.4^{+\infty}_{+0.3}$, respectively. (6 figures, 6 tables) (auth)

14219 SPECTROSCOPY OF ^{67}Zn VIA ANALOG RESONANCES IN ^{67}Ga. Sinclair, J.W.D.; Gearhart, N.L.; Hausman, H.J.; Morgan, J.F.; Norton, G.A.; Steiner, W.S. (Department of Physics, The Ohio State University, Columbus, Ohio 43210). Phys. Rev. C 8: No. 4, 1413-1420 (Oct 1973).

The spins of the analog resonances of some low-lying states of ^{67}Zn have been deduced from the ^{66}Zn(p, pγ)^{66}Zn(1.04-MeV) reaction in the triple-angular-correlation geometry of Goldfarb and Seyler. Excitation of the elastic and inelastic protons (0^+, ground state; 2^+, 1.04 and 1.87 MeV) have been measured at 90 and 130°. The following spin and parity assignments have been made for some of the parent states in ^{67}Zn: 0.390 MeV, $3/2^-$; 0.978 MeV, $5/2^+$; 2.273 MeV, $5/2^+$; 2.407 MeV, $5/2^+$; and 2.797 MeV, $5/2^+$. Four other resonances for which definitive spin assignments could not be made were also studied. NUCLEAR REACTIONS ^{66}Zn(p, p), ^{66}Zn(p, p_1), ^{66}Zn(p, p_2), measured σ (E), E = 3.0–5.8 MeV. Deduced l of IAS in ^{67}Ga. Measured J of IAS in ^{67}Ga using ^{66}Zn(p, $p_1\gamma$) angular correlations. Enriched target. (auth)

14220 REACTION CROSS SECTIONS FOR ^{16}O WITH Fe, Ni, Ge, AND Zr. Obst, A.W.; McShan, D.L.; Greenfield, M.B.; Holub, R.; Davis, R.H. (Department of Physics, The Florida State University, Tallahassee, Florida 32306). Phys. Rev. C 8: No. 4, 1379-1384 (Oct 1973).

Relative excitation functions for the total neutron production and total charged-particle (proton, α) production above 2 MeV from ^{16}O bombardment of natural targets of Fe, Ni, Ge, and Zr have been measured at $\theta_{lab} = 90°$ and in the bombarding energy range from 30 to 60 MeV. For the most part, the onset of reaction product yields agrees well with the barrier heights as determined from ^{16}O elastic scattering. Absolute measurements for light charged-particle production were also made on Fe and Ni at $\theta_{lab} = 60°$ and in the bombarding energy range from 37 to 60 MeV. Combined with an average number of emittted charged particles calculated from Weisskopf-Ewing evaporation theory and with the effects of angular momentum included, the results when compared to optical-model reaction cross sections suggest a moment of inertia of one half the rigid-body value. (auth)

14221 STUDY OF ^{82}Sr, ^{84}Sr, AND ^{86}Sr WITH THE (p, t) REACTION. Ball, J.B.; Pinajian, J.J. (Oak Ridge National Laboratory, Oak Ridge, Tennessee, USA); Larsen, J.S.; Rester, A.C. Phys. Rev. C 8: No. 4, 1438-1447 (Oct 1973).

The (p, t) reaction has been studied on the even stable isotopes of strontium at a proton energy of 31 MeV. Triton spectra were obtained with a magnetic spectrograph which yielded an over-all experimental resolution of 18 keV. The experimental angular distributions are compared with two-nucleon-transfer distorted-wave Born-approximation calculations to make spin-parity assignments for the observed levels and to extract enhancement factors. Energy level and transition intensity systematics are presented for the low-lying levels of these isotopes with particular emphasis on the L = 0 transitions. A number of new spin-parity assignments are made for ^{86}Sr and ^{84}Sr and the previously unreported level structure of ^{82}Sr is presented. The ground-state mass of ^{82}Sr is also determined from the measured Q values. (auth)

14222 NUCLEAR SPECTROSCOPY OF ^{62}Cu WITH ^{63}Cu(d, t) AND ^{64}Zn(d, α) REACTIONS. Daehnick, W.W.; Park, Y.S.; Dittmer, D.L. (Nuclear Physics Laboratory, University of Pittsburgh, Pittsburgh, Pennsylvania 15260). Phys. Rev. C 8: No. 4, 1394-1405 (Oct 1973).

The level structure of ^{62}Cu was studied by the reaction ^{63}Cu(d, t)^{62}Cu (at E_d = 16 and 12 MeV), by ^{63}Cu(^{3}He, α)^{62}Cu and ^{62}Ni(^{3}He, t)^{62}Cu (at $E_{^3He}$ = 18 MeV), and by ^{64}Zn(d, α)^{62}Cu (at E_d = 12.08 MeV). Experimental resolution varied between 7–9 keV (for d, t) and 12–15 keV (for experiments involving charge-two projectiles). Angular distributions were obtained for the (d, t) and (d, α) reactions for the $15° \geq \theta_L \geq 45°$ and $12° \geq \theta_L \geq 90°$, respectively, and spectroscopic factors and L transfers were extracted by distorted-wave Born-approximation (DWBA) analyses for about 60 states below 3 MeV excitation. About half of these levels had not been studied previously. In spite of the relatively low deuteron energy most (d, α) angular distributions showed systematic direct-reaction structure and were well fitted by DWBA calculations without variable parameters. A number of unique $J^\pi = 1^+$ and $J^\pi = 3^+$ assignments could be made. Narrow J^π limits are given for most other levels. No states with J > 5 were identified in the energy region investigated. (auth)

14223 ^{86,88}Sr(d,^{3}He)^{85,87}Rb REACTIONS AND A POSSIBLE Z = 38 MAGIC NUMBER. Comfort, J. R.; Duray, J. R.; Braithwaite, W. J. (Joseph Henry Laboratories, Princeton University, Princeton, New Jersey 08540). Phys. Rev. C; 8: No. 4, 1354-1362(Oct 1973).

The ^{86,88}Sr(d, ^{3}He)^{85,87}Rb reactions were studied at a bombarding energy of 28 MeV and angular distributions were obtained for all observed states. Spectroscopic factors were extracted from distorted-wave Born-approximation calculations of the cross sections. These spectroscopic factors, and those from the ^{86,88}Sr(^{3}He, d)^{87,89}Y reactions, were renormalized to satisfy sum-rule constraints. Some configuration mixing in the ground state of ^{85}Sr is inferred. The two $g_{9/2}$ neutron holes in ^{86}Sr produce very sizable rearrangements of the proton orbital populations in ^{86}Sr. (auth)

14224 HIGH PRECISION STUDIES ON THE LEVEL SCHEME OF ^{80}Se BY THE RESONANT-SCATTERING METHOD. Szichman, H. (Nuclear Physics Department, Soreq Nuclear Research Center, Yavne, Israel). Phys. Rev. C 8: No. 4, 1429-1432 (Oct 1973).

The energies and reduced strengths of the γ rays following deexcitation of the 7818.9-keV highly excited level in ^{80}Se reached by the (γ,γ') reaction, were measured using a nickel capture γ source. The level scheme deduced for this nucleus is presented. Measurements of the angular distributions of the scattered radiation permitted the assignment of spin values for most of the low-lying levels in this nucleus. Parity determinations were made comparing the reduced strengths with the statistics of known E1 and M1 transitions. (auth)

14225 PHOTON SCATTERING CROSS SECTIONS OF ^{88}Sr IN THE ENERGY REGION 8.6 TO 12 MeV. Datta, S.; Allen, J.S. (Department of Physics, University of Illinois, Urbana, Illinois 61801). Phys. Rev. C 8: No. 4, 1421-1424 (Oct 1973).

Monoenergetic γ rays from the University of Illinois bremsstrahlung monochromator have been used to measure the cross sections for both elastic scattering from ^{88}Sr and inelastic scattering to the first excited state of ^{88}Sr. The incident γ rays were selected in energy bins of about 100 keV in the energy region between 8.6 and 12 MeV. There are several maxima and minima in the cross sections similar to those observed in similar experiments with ^{90}Zr. The most prominent maximum in the elastic scattering occurs at about 9.5 MeV. This roughly coincides with the excitation energy of the most prominent E1 state predicted by Goulard, Hughes, and Fallieros. (auth)

14226 DIRECTIONAL CORRELATIONS OF GAMMA RAYS IN ^{79}Br. Ludington, M.A. (Physics Department, Albion College, Albion, Michigan 49224); Gardulski, P.L.; Wiedenbeck, M.L. Phys. Rev. C 8: No. 4, 1319-1323 (Oct 1973).

The γ radiation following the decay of ^{79}Kr to levels in ^{79}Br has

been studied with Ge(Li) detectors. 40 transitions were observed, including 4 which were previously unreported. γ-γ directional-correlation measurements have been made using two Ge(Li) detectors. The E2/M1 amplitude mixing ratios for several transitions in ^{79}Br have been determined from these directional-correlation measurements. The results of these measurements together with conversion coefficients and logft values have made it possible to assign spins and parities to some of the excited levels. (auth)

14227 EFFECT OF NUCLEON CORRELATIONS IN THE REACTION ^{12}C(p,2p)^{11}B IN FRAMEWORK OF THE GLAUBER THEORY. Ermakov, K. N.; Zhalov, M. B.; Starodubskii, V. E. (Leningrad Inst. of Nuclear Physics). Yadern. Fiz.; 18: No. 4, 801-808(Oct 1973). (In Russian).

Effect of correlations in the reaction ^{12}C(p,2p)^{11}B at the energy of 1 GeV is considered. The calculations are carried out by means of the distorted-wave method. The used optical potentials are constructed in framework of the Glauber theory. The proton bound-state function is calculated for the Woods-Saxon potential. Effect of the correlations in the elastic scattering at 0.5 and 1.0 GeV is studied separately. Results of the calculations are compared with the experimental data. (auth)

14228 NUCLEAR ORIENTATION STUDIES AT LOW TEMPERATURES. Daly, P. W. Vancouver, B. C.; University of British Columbia (1973). National Library of Canada, Ottawa. Thesis (Ph. D.).

The interaction between the nuclear magnetic moment and the hyperfine field in ferfomagnetic and antiferromagnetic materials was used to orient radioactive nuclei at low temperatures. The ^{59}Fe nucleus was studied in an iron sample; a result obtained at a temperature of 15 mK indicated an upper limit for the magnetic moment of ^{59}Fe of $|\mu| < 0.9\ \mu_N$. The anisotropy of gamma radiation emitted in the decay of ^{103}Ru oriented in ferromagnetic iron was measured. A lower limit was placed on the magnetic moment at 11 mK: $|\mu| > 0.15\ \mu_N$. The sign of the E2/M1 mixing ratio for the 497-keV gamma transition was found to be negative. Nuclear orientation was also used to observe the spin-flow transition in antiferromagnetic $MnCl_2 \cdot 4H_2O$. By observing the gamma-ray anisotropy in the decay of radioactive ^{54}Mn; it was found that at 60 mK the transition occurs for a critical field of $H_c = 6.50 \pm 0.05$ kG applied along the crystallographic c-axis. In the spin-flop phase, the electronic spins point at an angle of 71° to this axis. These data allow the following values of the molecular exchange and anisotropy fields to be determined: $H_E = 11.7 \pm 0.6$ kG and $H_A = 2.0 \pm 0.1$ kG. The nuclear orientation of ^{207}Bi in cobalt was studied to determine the hyperfine field. An unexpectedly small gamma-ray anisotropy was observed; however, saturation of the effect occurred at a relatively high temperature. These results indicate that only a fraction (~12%) of the Bi nuclei felt a large hyperfine field (~600 kG). Comparison of the anisotropies of the 1.064 MeV and the 1.761 MeV gamma rays shows that the former effect is enhanced, possibly because of the long half-life of the 1.633-MeV intermediate state. (RWR)

14229 DECAY OF ^{83}Y^{m} AND ^{83}Y^{g} TO LEVELS IN ^{83}Sr. Simpson, M. L.; Kitching, J. E.; Mark, S. K. (McGill Univ., Montreal). Can. J. Phys.; 51: No. 10, 1098-1103(15 May 1973). The decays of 2.85 min ^{83}Y^{m} and of 7.06 min ^{83}Y^{g} were investigated. Two photons are observed to be associated with the metastable decay, and one depopulates a 4.95 s metastable level at 259.3 keV in ^{83}Sr. Seventeen γ rays are associated with the ground state decay. The γ-γ coincidence and internal conversion measurements are carried out. Decay schemes are proposed with deduced log ft values for the various decay branches. Probable spin-parity assignments are given. The nature of the states involved are discussed within the context of the shell model. (auth)

14230 NEUTRON-PROTON SHELL MODEL MULTIPLETS IN ^{88}Y AND ^{90}Y FROM A STUDY OF THE (α,nγ) REACTION. Baer, H. W.; Bunting, R. L.; Glenn, J. E.; Kraushaar, J. J. (Univ. of Colorado, Boulder). Nucl. Phys.; A218: No. 2, 355-317 (1974).

The nonselective nature of the (α,nγ) reaction was used to complement information from charged-particle reactions on the level structure of ^{88}Y and ^{90}Y. The γ-ray spectra were recorded with a 25 cm^3 Ge(Li) detector at 90° to the beam using primarily targets of $^{85}Rb_2CO$ and $^{87}Rb_2CO_3$ and α-particle energies of 11.8, 12.2 and 13.0 MeV. The resulting transitions were accommodated in level schemes that involved primarily the following shell model configurations: $(\pi p_{\frac{1}{2}})^1(\nu g_{\frac{9}{2}})^{-1}$, $(\pi g_{\frac{9}{2}})^{-1}(\nu g_{\frac{9}{2}})^1$, $(\pi p_{\frac{1}{2}})^1(\nu p_{\frac{1}{2}})^{-1}$, $(\pi f_{\frac{5}{2}})^{-1}(\nu g_{\frac{9}{2}})^{-1}$ in ^{88}Y and $(\pi p_{\frac{1}{2}})^1(\nu d_{\frac{5}{2}})^1$, $(\pi g_{\frac{9}{2}})^1(\nu d_{\frac{5}{2}})^1$, $(\pi p_{\frac{1}{2}})^1(\nu s_{\frac{1}{2}})^1$ in ^{90}Y. (auth)

14231 NUCLEAR MATRIX ELEMENTS FROM L/K ELECTRON CAPTURE RATIOS IN ^{59}Ni DECAY. Chew, W. M. (Georgia Inst. of Tech., Atlanta); Xenoulis, A. C.; Fink, R. W.; Pinajian, J. J. Nucl. Phys.; A218: No. 2, 372-380(1974).

Using a recent theoretical method, the ratio of nuclear matrix elements $R = ({}^{V}F^{0}_{120} - \sqrt{3/4}\,{}^{A}F^{1}_{121}/{}^{V}F^{1}_{111})$ was determined to be either $20.50^{+0.33}_{-0.31}$ or $25.22^{-0.33}_{+0.31}$ in the second-forbidden nonunique decay of 8×10^4 y ^{59}Ni. These values of R were obtained from a value of $L_2/K = 0.008 \pm 0.002$ found by subtracting the theoretical ratio $(L_1 + L_3)/K = 0.113$ (based on $Q_{EC} = 1070 \pm 8$ keV) from the total ratio $L/K = 0.121 \pm 0.002$, which was measured with a reactor-produced, doubly-mass-separated ^{59}Ni source introduced as gaseous nickelocene, $(C_5H_5)_2Ni$, into a wall-less, anticoincidence, multiwire proportional counter. The 854-1008 eV L and the 8.33 keV K peaks were measured simultaneously. (auth)

Nuclear Properties and Reactions, 90 ≤ A ≤ 149

Refer also to abstracts 14153, 14154, 14160, 14172, 14186, 14215, 14220, 14228, and 14258.

14232 (ANL-TRANS-947) FISSION OF MEDIUM AND HEAVY NUCLEI INDUCED BY HEAVY IONS, Ar AND Kr. Hanappe, F.; Ngo, C.; Peter, J.; Tamain, B. (Paris-11 Univ., 91, Orsay (France). Inst. de Physique Nucleaire). Nov 1973. Translation of SM-174/41. (CONF-730823-20). 27p. Dep. NTIS $3.50.

From 3rd symposium on physics and chemistry of fission; Rochester, New York, USA (13 Aug 1973).

Using krypton and argon ion barbombardment the fission cross sections of the compound nucleus on a series of target nuclei were obtained. For the argon-initiated reactions the effect of the angular momentum on the fission barrier height was studied, and the mass and kinetic energy spectra of fragments produced by fission of the compound nucleus were determined. The values of the mean total kinetic energies and the total kinetic energy and mass distribution widths were compared with the predictions of different models. In the case of krypton a new type of reaction was observed: partial fusion between the projectile and the target and then disintegration into two fragments of masses similar to those of the projectile and the target. The effect of the mass of the target nucleus on this phenomenon was studied. (JFP)

14233 (COO-535-693) NUCLEAR PHYSICS LABORATORY TECHNICAL PROGRESS REPORT, NOVEMBER 1, 1972-NOVEMBER 1, 1973. (Colorado Univ., Boulder (USA). Dept. of Physics and Astrophysics). 1 Nov 1973. Contract AT(11-1)-535. 127p. Dep. NTIS $8.50.

The experimental program was divided into the areas of nuclear physics (charged-particle experiments, gamma-ray experiments and beta decay, neutron time-of-flight experiments, x-ray fluorescence analysis, other activities), intermediate energy physics, and apparatus and facility development. The energy-loss spectrograph, rotating-beam neutron time-of-flight spectrometer, and cyclotron and the research done using these facilities are described. The theoretical program has concentrated on the effects of two-step processes in nuclear reactions. The trace element analysis program continued, and a neutron beam for cancer therapy is being developed. Lists of publications and personnel are also included. (RWR)

For title listings of selected papers see: 12495, 12519, 12998, 13959, 14129, 14150-14152, 14175-14177, 14194-14198, 14216, 14234-14236, and 14259.

14234 (COO-535-693, pp 2-3) ^{107}Ag(p,d)^{106}Ag AND ^{108}Pd(p,d)^{107}Pd REACTIONS. Peterson, R. J.; Kraushaar, J. J.; Ridley, B. W.; Ristinen, R. A. 1 Nov 1973.

In nuclear physics laboratory technical progress report, November 1, 1972-November 1, 1973.

14235 (COO-535-693, pp 7-8) ^{90,92,94,96}Zr(p,α) ^{87,89,91,93}Y REACTIONS. Peterson, R. J.; Rudolph, H. 1 Nov 1973.

In nuclear physics laboratory technical progress report, November 1, 1972-November 1, 1973.

14236 (COO-535-693, pp 28-29) LEVEL STRUCTURE OF ^{106}Ag BY THE ^{103}Rh(α,nγ) REACTION. Bunting, R. L.; Chinn, S.; Kraushaar, J. J. 1 Nov 1973.

In nuclear physics laboratory technical progress report, November 1, 1972-November 1, 1973.

14237 (IAEA-153, pp 155-172) ROLE OF PHYSICAL TRENDS IN NEUTRON DATA EVALUATION. Csikai, J.; Angeli, I.; Boedy, Z. T. (Kossuth Univ., Debrecen, Hungary). 1973.

From proceedings of a panel on neutron nuclear data evaluation; Vienna, Austria (30 Aug 1971).

Different trends and tendencies are surveyed for (n,total), (n,2n), (n,γ), (n,p), and (n,α) cross sections with special emphasis on the first two cases. The process of observation and interpre-

tation of such trends has great scientific interest and can serve as a guide in checking the data; also, they can be used in the estimation of cross section values that have not been measured. For (n,total) cross sections no definite odd–even and N – Z effects were observed; the existence of a fine structure for light nuclei was established and described by a simple formula ("binding energy effect"). In the case of (n,2n) cross sections at constant excess energy above threshold there exists a definite N – Z dependence. The odd–even and shell effects, observed previously, are mainly due to the threshold energies. (9 figures, 1 table) (auth)

14238 (IAEA-153, pp 173-188) RECOMMENDED VALUES OF (n,2n) AND (n,total) CROSS SECTIONS. Body, Z. T.; Csikai, J.; Angeli, I. (Kossuth Univ., Debrecen, Hungary). 1973.

From proceedings of a panel on neutron nuclear data evaluation; Vienna, Austria (30 Aug 1971).

The origin and the role of different errors in the measurements are discussed with particular interest concerning their possible elimination or correction. With a generalized averaging procedure most probable values were calculated for (n,total) and (n,2n) cross sections by using experimental results from the literature. In the case of (n,2n) cross sections further values were obtained by interpolation and extrapolation using N – Z dependence previously observed; the cross sections for elements were also calculated by averaging over isotopic abundances. (1 figure, 6 tables) (auth)

14239 (IAEA-153, pp 189-201) INTERPRETATION OF TRENDS IN TOTAL NEUTRON CROSS SECTIONS. Angeli, I.; Csikai, J. (Kossuth Univ., Debrecen, Hungary). 1973.

From proceedings of a panel on neutron nuclear data evaluation; Vienna, Austria (30 Aug 1971).

For medium and heavy nuclei, it is shown that the smooth dependence of the total neutron cross sections on mass number can be explained by a simple semiclassical picture, the so-called "nuclear Ramsauer effect", with reasonable values of the real optical potential depth and surface thickness. At 14 MeV neutron energy, data seem to suggest a strong surface absorption. Extending the investigation to different energies indicated that the above picture can be applied to the interpretation of the total cross sections for E > 10 MeV only, although a simple formula of practical interest holds also for lower energies. Some refinement can be attained by using a corrected form of the black nucleus formula. For light nuclei, a correlation between the nuclear radius parameter, r_0, and the average binding energy per nucleon, E/A, was found. Results of Hartree–Fock calculations for light nuclei also show this correlation. (8 figures) (auth)

14240 (JINR-P3-7245) ALPHA DECAY OF NEUTRON RESONANCES IN THE $^{149}Sm(n,\alpha)^{146}Nd$ REACTION. Winiwarter, P.; Niedzwiedziuk, K.; Popov, Yu. P.; Rumi, R. F.; Salatskii, V. I.; Furman, V. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1973. 16p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The values of the total and partial σ widths of the neutron resonances of the ^{150}Sm nucleus, obtained from the $^{149}Sm(n,\alpha)^{146}Nd$ reaction in the neutron energy range of 0.025 to 40 eV, are presented. The experimental results are compared with the predictions of the statistical α-decay model of highly excited states. The form of the $E_0 = 0.87$ eV resonance is described, taking into account the Doppler effect, as well as the interference between the resonances of 0.87 and 0.098 eV. (6 figures, 2 tables) (auth)

14241 AVERAGE FISSION NEUTRON CROSS SECTION FOR $^{93}Nb(n,\alpha)^{90}Y$, $^{90}Zr(n,p)^{90}Y$, $^{93}Nb(n,\alpha)^{90m}Y$, AND $^{90}Zr(n,p)^{90m}Y$ REACTIONS. Lee, C.; Yim, Y. C.; Chung, K. S.; Bak, H. I. Daehan Hwahak Hwoejee; 17: No. 1, 20-24(1973).

The average fission neutron cross sections were determined for the following reactions, $^{93}Nb(n,\alpha)^{90}Y$, $^{90}Zr(n,p)^{90m}Y$, and $^{90}Zr(n,p)^{90}Y$. The cation exchange column was used for the quantitative separation of the product nuclides using α-hydroxyisobutyric acid as the eluent. The absolute activities of ^{90m}Y and ^{90}Y were determined by gamma-ray spectrometry and a calibrated 2π gas flow counter, respectively. The cross sections of $^{93}Nb(n,\alpha)^{90}Y$, $^{90}Zr(n,p)^{90}Y$, $^{93}Nb(n,\alpha)^{90m}Y$, and $^{90}Zr(n,p)^{90m}Y$ reactions were found to be 0.14 ± 0.01 mb, 0.83 ± 0.02 mb, 0.018 ± 0.002 mb, and 0.033 ± 0.002 mb, respectively. The possible use of ^{90}Y instead of ^{90}Y was discussed as a better means for the determination of niobium. (1 figure, 3 tables) (Korean Sci. Abstr.)

14242 STUDY OF THE $^{96}Mo(^3He, d)^{97}Tc$ REACTION. Medsker, L.R.; Braid, T.H.; Yntema, J.L. (Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. C 8: No. 4, 1425-1428 (Oct 1973).

The $^{96}Mo(^3He, d)^{97}Tc$ reaction has been restudied with 35.4-MeV ^3He particles from the Argonne cyclotron. Experimental angular distributions are compared with distorted-wave Born-approximation values and spectroscopic factors. Several previously observed doublets were resolved and proposed spin assignments were confirmed by comparing the present results with those of other measurements. (auth)

14243 COMPOUND-NUCLEUS CONTRIBUTION FOR (p, α) REACTION FROM Sn AND Cd ISOTOPES. Chan, K.C.; Rao, G.R.; Cohen, B.L.; Degnan, J.H.; Shabason, L. (Nuclear Physics Laboratory, University of Pittsburgh, Pittsburgh, Pennsylvania 15260). Phys. Rev. C 8: No. 4, 1363-1369 (Oct 1973).

A clean separation of compound-nucleus and direct-reaction processes in (p, α) reaction was made for 12- and 17-MeV protons bombarding on Cd and Sn isotopes. Results indicated the compound-nucleus contributions for ^{112}Sn give isotropic angular distribution for the α-particles. Shapes of the energy spectra of emitted α-particles were in good agreement with statistical theory calculation, but absolute cross sections were larger than predicted by a factor of 2 to 7. (auth)

14244 PROPERTIES OF THE ODD-MASS IODINE ISOTOPES IN A PARTICLE-PHONON COUPLING SCHEME. Almar, R.; Civitarese, O.; Krmpotić, F. (Departamento de Física, Facultad de Ciencias Exactas, Universidad Nacional de La Plata, La Plata.C.C.67, Argentina). Phys. Rev. C 8: No. 4, 1518-1524 (Oct 1973).

A qualitative description of the low-lying states of odd-mass iodine nuclei is proposed in terms of a three-proton cluster coupled to a harmonic-quadrupole vibrational field. Using reasonable values for the parameters involved, the calculated spectrum of ^{131}I is in good agreement with experimental data. The comparison with experiments is also satisfactory for the one-body stripping strengths, B(E2) transition probabilities, and magnetic-dipole and electric-quadrupole moments. We do not obtain good results concerning the energies of the lightest I isotopes. (auth)

14245 QUADRUPOLE–OCTUPOLE ANHARMONICITIES IN SPHERICAL NUCLEI. Raduta, A. A. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 18: No. 7, 901-942(1973).

Two models for treating the coupling of quadrupole and octupole vibrations are presented. The quasi-bosonic structure for the quadrupole and octupole operators is preserved. One obtains the nonlinearity of the equations of motion for these two kinds of vibrations by supplementing the conventional Hamiltonian which contains the pairing-, quadrupole–quadrupole and octupole–octupole interactions with a term of third order in the moments. One determines the coupling of quadrupole and octupole vibrations, by the anharmonic structure of the quadrupole and octupole operators. The dispersion equations for the single and two phonon collective states (2^+, 3^-, 1^-, 2^-, 3^{-1}, 4^-, 5^-) are written in the two considered models and the transition probabilities B (E2,$2^- \rightarrow 0^+$), B (E3,$3^- \rightarrow 0^+$), B (E3,$3^{-1} \rightarrow 0^+$) are found as well. Both alternatives are tested for the case of ^{114}Sn. (auth)

14246 EFFECT OF DIFFERENT TOTAL ATOMIC SCATTERING CROSS SECTIONS ON DSAM CALCULATIONS. Latta, B. M.; Scanlon, P. J. (Queen's Univ., Kingston, Ont.). Nucl. Instrum. Methods; 114: No. 1, 179-181(1974).

A comparison of the nuclear lifetime calculations of Kregar et al. and Monte Carlo calculations using both their total cross section and one from Meyer's multiple scattering theory is made. (3 figures) (auth)

14247 TRANSMISSION OF LEAD-CAPTURE GAMMA RAYS WITH TIN ABSORBER. Kawarasaki, Y. (Japan Atomic Energy Research Inst., Tokai). Nucl. Instrum. Methods; 114: No. 1, 153-155(1974).

Transmission measurements of thermal-neutron-capture gamma rays in lead were made with a tin absorber of varied thicknesses for direct determination of the resonance energy and for obtaining an effective nuclear cross section. It was found that resonance occurred at the energy of 6729.8-keV gamma rays from $^{204}Pb(n,\gamma)$. The gamma-ray energy from $^{206}Pb(n,\gamma)$ was then measured to be 6738.1 keV. The effective absorption cross section of the resonant level in ^{120}Sn was measured to be (0.48 ± 0.05) b. The usefulness of this method is briefly discussed. (2 figures) (auth)

14248 ISOMER ACTIVATION DATA FROM EXPERIMENTS BY HIGH ACTIVITY ^{60}Co SOURCES. Lakosi, L.; Csuros, M.; Veres, A. (Inst. of Isotopes, Budapest). Nucl. Instrum. Methods; 114: No. 1, 13-15(1974).

The flux density of Compton-scattered γ rays was calculated for cylindrical sources. Integral cross sections obtained by measuring ^{111m}Cd and ^{115m}In activities excited by ^{60}Co sources are in good agreement with data evaluated from earlier radioisotope measurements and accelerator results. (1 figure, 1 table) (auth)

14249 DECAY OF ^{95}Y ($T_{\frac{1}{2}}$ = 10.3 mn). Cavallini, P.; Monnand, E.; Moussa, A. (CEN, Grenoble, France). J. Phys. (Paris); 34: No. 8, 675-681(Aug 1973). (In French).

The decay of ^{95}Y was investigated; its half-life was found to be $T_{\frac{1}{2}}$ = 10.3 ± 0.2 mn. The intensity of the β decay branch to the ground state of ^{95}Zr was found to be (70 ± 4)% of the total β decay. The γ-radiation from ^{95}Y was studied using Ge(Li) detectors by themselves and in coincidence. The 43 out of the 44 γ-rays observed were attributed to the ^{95}Zr decay scheme. (auth)

14250 DIRECT DETERMINATION OF THE TRANSITION PROBABILITY FOR THE ^{149}Dy → ^{149g}Tb DECAY THROUGH ELECTRON CAPTURE. Gauvin, H.; Hahn, R. L.; Lagarde, B.; Le Beyec, Y.; Lefort, M. (Paris Univ., Orsay, France). Compt. Rend., Ser. A, B; 277: No. 4, 107-109(23 Jul 1973). (In French).

By measuring directly the α decay of the ^{153}Er parent nucleus and the ^{149g}Tb daughter nucleus, the electron capture of ^{149}Dy was shown to lead to the ground state of ^{149}Tb in 47.5 ± 5% of the cases. (auth)

14251 MAGNETIC MOMENT OF THE 188 keV EXCITED STATE IN ^{125}I. Karlsson, E.; Windahl, R. A.; Arnesen, A.; Noreland, T. (Uppsala Univ.). Z. Phys.; 265: No. 1, 65-68 (Oct 1973).

The g-factor of the 188-keV $^3/_2^+$ state in ^{125}I was determined with the perturbed angular correlation method to be g = 0.70(5). This result is close to the value reported earlier for the corresponding level in ^{127}I. (GE)

14252 (t,p) REACTION TO THE LOW-LYING LEVELS OF THE ZIRCONIUM ISOTOPES. Flynn, R. R.; Beery, J. G.; Blair, A. G. (Los Alamos Scientific Lab., NM). Nucl. Phys.; A218: No. 2, 285-306(1974).

The (t,p) reaction on the isotopes ^{90,92,94,96}Zr was carried out at a bombarding energy of 20 MeV. Only weakly excited 0^+ states are observed in ^{92}Zr and ^{94}Zr while the first excited 0^+ state in ^{96}Zr is strongly excited. No 0^+ states are seen in ^{98}Zr. The results indicate a trend for ground state excitations intermediate between simple shell model and pairing vibration theory. The low-lying levels of ^{92}Zr and ^{94}Zr are described by detailed shell model calculations. There is no indication in these nuclei of the rapid onset of deformation previously reported in ^{100}Zr, nor is there any evidence for an excited rotational band structure in any of the zirconium nuclei studied. (auth)

Nuclear Properties and Reactions, 150 ≤ A ≤ 189

Refer also to abstracts 12800, 13190, 14186, 14217, 14232, and 14237–14240.

14253 (FRNC-TH-417) STUDY AND INTERPRETATION OF LEVELS OF THE ^{175}Ta, ^{169}Lu, AND ^{175}Lu NUCLEI OBTAINED BY ON-LINE SPECTROMETRY. Foin, C. (Grenoble-1 Univ., 38 (France)). 1973. 173p. (In French). Dep. NTIS (U.S. Sales Only) $10.75.

Thesis.

Beam γ spectrometry was used to study the three nuclides ^{175}Ta, ^{169}Lu and ^{175}Lu obtained by (α,xn) and (p,xn) reactions. The intrinsic energies of states unobserved in radioactivity measurements were determined. The existence of rotation bands built on the different states was established for each of these nuclides. Only the $^1/_2^+$(411) rotation band of ^{175}Ta was not developed. In the case of weakly perturbed rotation bands, the energies were studied in terms of a limited expansion in the angular momentum powers. In the case of highly perturbed bands, the coupling was calculated in an exact manner. It is shown that for ^{169}Lu, an expansion of rotation energy in terms of ω^2 (ω = angular velocity) converges more rapidly than an expansion in I(I + 1). A four parameter expression gives an excellent fit up to $^{21}/_2$ for the ground state band. In addition, a similarity is observed between the $2J/\hbar^2 = f(\omega^2)$ curves for ^{169}Lu and ^{171}Lu and those of their isotones ^{168}Yb and ^{170}Yb. The existence of an isomeric state of high spin was established for ^{175}Ta (E = 1568 keV; $T_{\frac{1}{2}}$ = 200 ns; $I(\pi) = (^{21}/_2)^+$. Other high spin states, interpreted as three quasiparticle states were also observed in ^{177}Ta and ^{179}Ta at comparable energies. (FR)

14254 (IKDA-73-6, pp 78-82) ANGULAR CORRELATIONS. Hofmann, S.; Krell, H. J.; Mueller, S.; Wien, K. Jul 1973. (In German).

In progress report, 1971–1972.

14255 (JINR-P4-7313) POSSIBILITY OF DETERMINING THE LINEAR AND LATERAL DEFORMATION OF HEAVY NUCLEI UPON ROTATION. Karadzhov, D.; Mikhailov, I. N.; Piperova, I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 11p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The consequences of the nonaxial deformation appearing due to the rotation when the nuclear spin is not equal to zero are considered, and estimates to the effects of such deformation on matrix elements of the electric quadrupole operator and also on the spin dependence of nuclear charge radii are given. (auth)

14256 INTERNAL CONVERSION OF THE 84.23 keV TRANSITION IN ^{176}Yb. Plch, J.; Zderadicka, J.; Kokta, L. (Inst. for Research, Prague). Czech. J. Phys.; 23: No. 11, 1181-1186(1973).

The conversion coefficient α_K = 1.48 ± 0.07 and the total conversion coefficient α = 8.05 ± 0.2 were determined by means of the 4π scintillation counter. (auth)

14257 E2/M1 MULTIPOLE MIXING RATIOS OF γ TRANSITIONS IN EVEN-EVEN DEFORMED NUCLEI. Krane, K.S. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Phys. Rev. C 8: No. 4, 1494-1499 (Oct 1973).

A summary is presented of the magnitudes and phases of previously measured E2/M1 multipole mixing ratios of γ transitions deexciting levels of the β- and γ-vibrational bands to the ground-state band in even-even deformed nuclei. A uniform phase, with few exceptions, is characteristic of transitions depopulating the γ band, while no systematic behavior is apparent for transitions from the β band; the magnitudes, while uniformly large, show little apparent systematic behavior among the nuclei in this region. Although none of the previously proposed theoretical interpretations is sufficient to explain both the magnitudes and relative phases of these mixing ratios, a phenomenological interpretation in terms of $\Delta K = 1$ band mixing through the intermediary of a $K = 1^+$ excitation is successful in predicting the relative magnitudes and phases in a number of cases. (auth)

14258 PREFORMATION PROBABILITY OF α-CLUSTERS IN RARE EARTH NUCLEI MEASURED BY MEANS OF THE (p,α) REACTION. Milazzo-Colli, L. (CISE, Milan); Braga-Marcazzan, G. M.; Milazzo, M.; Signorini, C. Nucl. Phys.; A218: No. 2, 274-284(1974).

The results of experimental measurements of (p,α) reactions on nuclei in the rare earth region are reported. It is shown that the dominant acting mechanism is precompound emission. From the absolute cross section value fitting, the α-preformation probability in the target nucleus can be evaluated. Its values are very close to the ones extracted from (n, α) analysis in the same mass region. (auth)

Nuclear Properties and Reactions, 190 ≤ A ≤ 219

Refer also to abstracts 14146, 14153, 14154, 14186, 14201, 14217, 14226, 14232, 14233, 14237, 14238, 14254, and 14255.

14259 (COO-535-693, pp 35-38) (p,n) REACTION ON HIGH Z ELEMENTS. Schery, S. D.; Fielding, H.; Goodman, C. D.; Lind, D. A.; Zafiratos, C. D. 1 Nov 1973.

In nuclear physics laboratory technical progress report, November 1, 1972–November 1, 1973.

14260 (IKDA-73-6) PROGRESS REPORT, 1971–1972. (Technische Univ. Darmstadt (F. R. Germany). Inst. fuer Kernphysik). Jul 1973. 185p. (In German). Dep. NTIS (U. S. Sales Only) $11.25.

The present activities report describes the activities in the fields of experimental and theoretical physics during 1971 and 1972. In addition, the report contains data on the personnel and a list of the scientific publications. (GE)

For title listings of selected papers see: 13807, 14178, 14201, 14217, 14254, 14261, and 14262.

14261 (IKDA-73-6, pp 30-33) ELECTROFISSION OF ^{209}Bi. Jul 1973. (In German).

In progress report, 1971–1972.

14262 (IKDA-73-6, pp 39-44) EXPERIMENTS WITH MUONS: ISOMER SHIFT. Jul 1973. (In German).

In progress report, 1971–1972.

14263 SHORT-LIVED α EMITTERS OF THORIUM: NEW ISOTOPES $^{218-220}$Th. Häusser, O.; Witthuhn, W.; Alexander, T.K.; McDonald, A.B.; Milton, J.C.D.; Olin, A. (Atomic Energy of Canada Limited, Chalk River Nuclear Laboratories, Chalk River, Ontario, Canada). Phys. Rev. Lett. 31: No. 5, 323-326 (30 July 1973).

The α-decay energies and half-lives of three new thorium isotopes, $^{218-220}$Th, have been measured by a simple recoil technique. The

observed α-decay widths are in qualitative agreement with Mang's shell-model theory. (auth)

14264 INTRANUCLEAR CASCADE STUDIES OF LOW-ENERGY PION-INDUCED NUCLEAR REACTIONS: POSSIBLE EFFECTS OF THE FINITE LIFETIME OF THE (3,3) ISOBAR. Harp, G.D.; Chen, K.; Friedlander, G. (Chemistry Department, Brookhaven National Laboratory, Upton, New York 11973); Fraenkel, Z.; Miller, J.M. Phys. Rev. C 8: No. 2, 581-593 (Aug 1973).

Intranuclear cascade studies have been made of low-energy pion-induced nuclear reactions which include the production and subsequent interactions of (3,3) isobars. The results are in fair to excellent agreement with the sparse amount of experimental information now available. Several experiments are outlined which could test the validity of some of the assumptions which were made in these calculations. (auth)

14265 NEUTRON-CAPTURE CROSS SECTIONS OF THE STABLE LEAD ISOTOPES. Allen, B.J.; Macklin, R.L.; Winters, R.R.; Fu, C.Y. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). Phys. Rev. C 8: No. 4, 1504-1517 (Oct 1973).

Neutron-capture yields for several samples of separated lead isotopes were obtained at the Oak Ridge electron linear accelerator, in the neutron energy range above 2.5 keV. These were analyzed for resonance-capture areas and parameters. The data are included in a new evaluation of lead cross-section data. (auth)

14266 FISSION OF U, Th, Bi, Pb, AND Au INDUCED BY 2.1-GEV ^{2}H IONS. Rahimi, F.; Gheysari, D.; Remy, G.; Tripier, J.; Ralarosy, J.; Stein, R.; Debeauvais, M. (Laboratoire de Physique Corpusculaire, Centre de Recherches Nucléaires de Strasbourg, 67-Strasbourg-Cronenbourg, France). Phys. Rev. C 8: No. 4, 1500-1503 (Oct 1973).

Cross sections of U, Th, Bi, Pb, and Au nuclei for binary and ternary fission induced by 2.1-GeV deuterons have been measured with plastic detectors. The binary-fission cross sections for uranium and lead have been found to be, respectively, 20 and 30% higher for deuterons compared to protons, whereas for the ternary fission the increases are by factors of 2 and 3, respectively. The variation of the cross section as a function of the incident deuteron energy and Z^2/A parameter of the target has been investigated, and a relation is proposed between these two variables. (auth)

14267 PRODUCTION OF NUCLEI IN REACTIONS WITH Kr AND Xe IONS. Oganesyan, Yu. Ts.; Penionzhkevich, Yu. E.; Nguyen Tak An; Nadkarni, D. M.; Gavrilov, K. A.; Kim De En; Yussonua, M. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 18: No. 4, 734-740(Oct 1973). (In Russian).

The Ta^{181}, Au^{197} and U^{238} targets were irradiated by the ions Ar^{40}, Kr^{84} and Xe^{136} and the yields of the nuclear reaction products were studied in the range $69 \leq Z \leq 95$. The yields of gold isotopes in the $190 \leq A \leq 200$ mass region produced by bombarding the Ta^{181} nuclei by the isotopes Ar^{40}, Kr^{84} and Xe^{136} were separately measured. The obtained data are analysed on the base of two possible reaction mechanisms: many-nucleon transfers and fission of compound system. (auth)

14268 EFFECTS OF NON-ORTHOGONALITY AND VIRTUAL EXCITATIONS IN DIRECT REACTIONS. III. Goldfarb, L. J. B.; Takeuchi, K. (Univ. of Manchester, Eng.). Nucl. Phys.; A218: No. 2, 405-417(1974).

Formulas are presented concerning the effects of virtual Coulomb excitation on the transfer of nucleons between heavy ions at energies below the Coulomb barrier. These formulas are applied towards calculation for the $^{208}Pb(^{16}O, ^{17}O)^{207}Pb$ reaction at 69.1 MeV. Generally, the effect is found to be of the order of 10% but it is not discernible owing to the small reaction cross sections. Suggestions are presented for extending the analysis to higher energies where the situation is more favorable. (auth)

Nuclear Properties and Reactions, A ≥ 220

Refer also to abstracts 12788, 14154, 14156, 14232, 14237–14239, 14255, 14263, 14266, 14267, 14296, 14297, and 14784.

14269 (ANL-7996, pp 8-28) FISSION AND OTHER NUCLEAR REACTIONS. Feb 1973.

In chemistry division annual report, July 1971–June 1972.

Research directed toward obtaining an understanding of the most fundamental features of the fission mechanism is continuing. The distribution of mass in the spontaneous fission (sf) of ^{253}Es was determined radiochemically. The mass-yield curve for the $^{235}Fm(n,f)$ reaction is given. Studies are reported on the correlation between fragment-mass-distribution fine structure, charge distribution, and nuclear structure for thermal-neutron-induced fission of ^{233}U and ^{235}U. Studies on physical measurements of fission-fragment mass and kinetic-energy correlations were continued with emphasis placed on the study of thermal-neutron-induced fission and spontaneous fission of various isotopes of the elements from thorium (Z = 90) to fermium (Z = 100). Previous work on isomeric γ rays was greatly expanded by the observation of 99 new γ transitions and by the inclusion of very low-energy γ rays and K x rays. Half-life, energy, and associated fragment mass were determined for 226 γ rays observed in a six-parameter experiment. These results were combined with those from previous work to assign 129 of the transitions to nuclei of specific Z and A. These results are tabulated. The angular distributions of α particles with respect to both light and heavy fission-fragment groups in the spontaneous fission of ^{252}Cf are given. Work on the discovery of new fissioning isomers and the accurate measurement of isomer half-lives and excitation functions is reported. Fission-barrier parameters are given for Cm and Pu isotopes. A semiempirical interpretation of nuclear fission based on deformed-shell effects is set forth; calculated potential-energy surfaces, mass-yield curves, and charge distributions are shown. Programs in nuclear reactions and the synthesis of heavy-element nuclides and heavy-element research using heavy-ion reactions are briefly reviewed. Work on understanding the mechanisms of nuclear reactions of GeV protons with nuclei is reported. The following aspects of the problem are being studied: the $^{12}C(p,pn)^{11}C$ cross section at 7.6 GeV; the reactions $^{63}Cu(p,n)^{63}Zn$ and $^{63}Cu(p,2n)^{62}Zn$ from 1.5 to 11.5 GeV; excitation function for the $^{25}Mg(p,2p)^{24}Na$ reaction from 3.0 to 11.5 GeV; software development for data-acquisition systems; and pulse-height defect of silicon surface-barrier detectors. (19 figures, 4 tables) (JGB)

14270 (ANL-7996, pp 29-44) NUCLEAR PROPERTIES, SPECTROSCOPY, AND STRUCTURE. Feb 1973.

In chemistry division annual report, July 1971–June 1972.

Alpha and electron-capture decay were studied for the actinides; ^{252}Es α groups and K/L ratios of E0 transitions in ^{238}Pu are tabulated, and the electron-capture decay scheme of ^{238}Am is shown. β and γ spectroscopy were used to determine the decay scheme of ^{239}Am to levels in ^{239}Pu, the decay scheme of ^{250m}Es to levels in ^{250}Cf, and the decay scheme of ^{241}Cm to levels in ^{241}Am. Electron binding energies of Cf for K, L, M, N, O, and P shells are tabulated. Other studies in this field include experimental limits on nonlinearities in the electromagnetic field and K-electron shakeoff in β decay. Single-nucleon transfer was studied in the heavy-element nuclides. The proton spectrum from the $^{240}Pu(d,p)$ reaction is given, along with single-particle energies of the N = 147 isotones. Two-quasi-particle states in the actinide nuclei were surveyed. The method of correlated quasi-particles was applied to theoretical studies in nuclear spectroscopy; occupation probabilities of levels in ^{234}U and ^{236}U are plotted. The program in atomic-beam nuclear magnetic resonance is briefly described. Half-lives were determined for ^{236}Np, ^{132}Cs, ^{240}Am, ^{250}Es, and ^{252}Es; branching ratios were found for ^{252}Es and $^{237,238,239}Am$; and ground-state spins were deduced for $^{237,238,239,240}Am$ and $^{250,252}Es$. (16 figures, 7 tables) (RWR)

14271 (BARC-690, pp 129-146) RADIOCHEMICAL STUDIES ON FISSION. 1973.

Research progress is reported on nuclear chemistry; topics considered include: recoil range and kinetic energy distribution in the thermal neutron fission of ^{245}Cm; mass distribution and recoil range measurements in the reactor neutron-induced fission of ^{232}U; fission yields in the thermal neutron fission of ^{241}Pu; highly asymmetric binary fission of uranium induced by reactor neutrons; and nuclear charge distribution in low energy fission. (DHM)

14272 (IAEA-153, pp 141-154) PRELIMINARY GRAPHICAL ANALYSIS OF SELECTED PLUTONIUM ISOTOPES CROSS SECTIONS OF THE ENDF/B-I AND II, KEDAK, AND UKNDL FILES. Ilberg, D.; Yiftah, S. (Israel Atomic Energy Commission, Yavne). 1973.

From proceedings of a panel on neutron nuclear data evaluation; Vienna, Austria (30 Aug 1971).

Within the framework of the comparative analysis of evaluated neutron data libraries, the paper presents preliminary graphical results for a few important cross sections of fast reactor materials obtained from the UKNDL, KEDAK, ENDF/B-I, and ENDF/B-II libraries. The elastic scattering, fission, and capture cross sections of ^{239}Pu, ^{240}Pu, ^{241}Pu, and ^{242}Pu in the energy range 0.1 to 10 MeV are plotted. (12 figures) (auth)

14273 (IAEA-153, pp 447-477) FAST NEUTRON CROSS SECTIONS OF ^{240}Pu: MEASURED RESULTS AND A COMPARISON WITH AN EVALUATED FILE. Smith, A. B.; Lambropoulos, P. P.; Whalen, J. F. (Argonne National Lab., IL). 1973.

From proceedings of a panel on neutron nuclear data evaluation; Vienna, Austria (30 Aug 1971).

Fast-neutron total cross sections and elastic- and inelastic-scattering cross sections of ^{240}Pu are reported. The total cross sections were measured from neutron energies of 0.1 to 1.5 MeV in increments of ~25 keV. The elastic-scattering cross sections were measured at ≲50 keV intervals from incident neutron energies of 0.3 to 1.5 MeV. The inelastic neutron excitation cross sections of states at 42 ± 5, 140 ± 10, 300 ± 20, 600 ± 20, and 900 ± 50 keV were measured. The experimental results are discussed in the context of the optical, compound-nucleus, and direct-reaction nuclear models including the effects of resonance width fluctuations and the fission process. The measured results are critically compared with the corresponding quantities in the evaluated nuclear data file ENDF/B. (6 figures, 1 table) (auth)

14274 (ORO-3924-14, pp 13-16) DECAY OF NEUTRON DEFICIENT Am ISOTOPES. 1973.

In angular momentum effects in nuclear reactions.

14275 (RT/FI-(73)22) NUCLEAR DATA AND INTEGRAL MEASUREMENTS CORRELATION FOR FAST REACTORS. Part 2. Review of Methods. Gandini, A. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 5 Jul 1973. 52p. Dep. NTIS (U. S. Sales Only) $4.75.

A critical review of a few methods proposed for cross section adjustment with integral measurements on fast reactors is presented. The methods selected, although not all-inclusive, represent important recent contributions on this field and all of them have in common a statistically-oriented approach. As a consequence of this common denominator, the intercomparisons are greatly simplified. Because of their relevance, emphasis has been given in particular to those arguments concerning the correlation among the group cross sections and the presence of systematic errors. (auth)

14276 (UCID-16392) UNDERSTANDING RESONANCE SELF-SHIELDING EFFECTS WITH THE HELP OF A SIMPLIFIED CROSS-SECTION MODEL. Kruger, H. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 13 Nov 1973. Contract W-7405-eng-48. 22p. Dep. NTIS $3.25.

Recent TART Monte Carlo calculations have shown discrepancies with F number measurements, as well as with measurements of fission density in ^{235}U and ^{239}Pu plates. These discrepancies have been attributed to the fact that the group-averaged TART cross sections cannot properly treat resonance self-shielding effects, because the width of TART groups is large compared with the width of cross-section resonances. This report attempts to explain the observed discrepancies with the help of a simplified cross-section model. Some of the results are plotted. The present TART cross-section group widths are also shown superimposed on a plot of ^{239}Pu and ^{235}U fission cross sections. It can be seen that the code will underpredict, overpredict, or correctly predict the fission density, depending on the thickness of fissionable material previously traversed by the neutron flux. Underprediction is almost certainly present in TART F number calculations for some LLL devices that have thick layers of fissionable material. The correct prediction on the front surface, followed by overprediction and then followed by a correct prediction, has been measured in a recent F number experiment. (7 figures) (RWR)

14277 (UCID-16393) TART CALCULATIONS USING THE NEW 2021 ENERGY GROUP CROSS SECTION LIBRARY COMPARED WITH B. CZIRR'S RESONANCE SELF-SHIELDING EXPERIMENTS. Bacon, L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 13 Nov 1973. Contract W-7405-Eng-48. 24p. Dep. NTIS $3.25.

Results from calculations using a 2021-energy-group cross section library with sufficient energy definition in the lower energy range to resolve the known resonances in ^{239}Pu and ^{235}U are compared with flat-plate resonance self-shielding experimental data. The results are somewhat ambiguous. The lower energy ranges appear to agree better with experimental data for small areal densities, but disagree more as the areal density increases. (20 figures) (RWR)

14278 RECONSTRUCTION OF PARTICLE MULTIPLICITY DISTRIBUTIONS USING THE METHOD OF STATISTICAL REGULARIZATION. Dakowski, M.; Lazarev, Yu. A.; Turchin, V. F.; Turovtseva, L. S. (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Instrum. Methods; 113: No. 2, 195-200(1973).

The problem of reconstructing particle multiplicity distributions from experimental data is discussed. Because of statistical errors involved in the data, the problem of reconstruction is "incorrectly posed", which results in the oscillatory behavior of the direct solution when the detection efficiency, ϵ, is substantially lower than 100%. It is shown that the method of statistical regularization used reconstructs the real distribution and allows one to estimate the rms errors of the results for $\epsilon \gtrsim 25\%$. The possibilities of the method are examined on the basis of the measurements of the multiplicity distribution of neutrons from spontaneous fission of ^{244}Cm. The application of the method to the determination of the multiplicity distributions for three Fm isotopes is presented. (4 figures, 3 tables) (auth)

14279 E2 AND E4 TRANSITION MOMENTS AND EQUILIBRIUM DEFORMATIONS IN THE ACTINIDE NUCLEI. Bemis, C.E. Jr.; McGowan, F.K.; Ford, J.L.C. Jr.; Milner, W.T.; Stelson, P.H.; Robinson, R.L. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). Phys. Rev. C 8: No. 4, 1466-1480 (Oct 1973).

Precision Coulomb-excitation experiments using ^{4}He ions have been performed in the actinide region ($230 \leq A \leq 248$) by the observation of elastic and inelastically scattered projectiles using a split-pole magnetic spectrometer equipped with a position-sensitive proportional detector. 12 even-A targets from ^{230}Th to ^{248}Cm have been investigated and the reduced quadrupole matrix element, $\langle||\gamma\ (E2)\ ||0\rangle$, and the reduced hexadecapole matrix element, $\langle 4||\gamma\ (E4)\ ||0\rangle$, have been determined from the experimental excitation probabilities of the 0^+, 2^+, and 4^+ states in the ground-state rotational bands. The values of B(E4, $0 \rightarrow 4$) range from 167 single-particle units for ^{234}U to essentially zero single-particle units for ^{244,246,248}Cm. Model-dependent deformation parameters, β_{20} and β_{40}, are extracted from the measured E2 and E4 transition moments for distributions of nuclear charge represented by deformed Fermi distributions and by a deformed homogeneous distribution. (auth)

14280 P-WAVE STRENGTH FUNCTIONS OF THORIUM-232 AND URANIUM-238. Goldsmith, M. (Bettis Atomic Power Lab., West Mifflin, PA). Nucl. Sci. Eng.; 52: No. 4, 461-465(Dec 1973).

A deformed optical potential, obtained by matching partial cross sections and the s-wave strength function, is used to calculate p-wave strength functions for ^{238}U and ^{232}Th. Results for ^{232}Th were $S_{1,\frac{1}{2}} = 1.9 \times 10^{-4}$ and $S_{1,\frac{3}{2}} = 1.8 \times 10^{-4}$. For ^{238}U, $S_{1,\frac{1}{2}} = 2.0 \times 10^{-4}$ and $S_{1,\frac{3}{2}} = 1.9 \times 10^{-4}$ were found. These results are consistent with thermal potential scattering cross sections of ~10.5 b for both nuclides. (2 figures, 1 table) (auth)

14281 MASS DISTRIBUTION OF FISSION PRODUCTS FOLLOWING PHOTOFISSION OF URANIUM-238. Swindle, D.; Wright, R.; Takahashi, K.; Rivera, W. H.; Meason, J. L. (Univ. of Arkansas, Fayetteville). Contract AT(40-1)-4282. Nucl. Sci. Eng.; 52: No. 4, 466-473(Dec 1973).

The mass-yield distribution of fission products following photofission of ^{238}U using bremsstrahlung energies of 22, 24, and 26 MeV were measured by radiochemically isolating the fission products belonging to 24 mass chains. The absolute activities of these nuclides were determined by β^- and γ counting techniques, and the cumulative fission yields were calculated relative to ^{140}Ba. The peak-to-valley ratio was found to be effectively constant; thus, the average photon-energy-inducing fission is essentially equal for all three energies studied. The fission yields in the mass region from 130 to 140 were examined for evidence of fine structure around A = 132 or A = 133. Although there were some deviations in this region from a "smooth curve," it did not yield conclusive evidence for fine structure. Finally, to set the slope of the heavy wing of the mass yield curves, cumulative fission yields of mass chains in the rare-earth region (in addition to others) were measured. (5 figures, 2 tables) (auth)

14282 STUDIES OF THE RECOIL PROPERTIES OF PRODUCTS OF THE INTERACTION OF ^{238}U WITH 11.5-GeV PROTONS. Starzyk, P.M.; Sugarman, N. (Department of Chemistry and the Enrico Fermi Institute, The University of Chicago, Chicago, Illinois 60637). Phys. Rev. C 8: No. 4, 1448-1465 (Oct 1973).

The thick-target thick-catcher recoil properties of 23 rare-earth nuclides, produced in the interaction of 11.5-GeV protons with uranium, were measured in the mass range 135 to 165. The ratio of the range of a product from multi-GeV protons to that from 450-MeV protons, called the "relative range", was calculated for all nuclides studied in the mass region 82-165. For neutron-excess products, the relative range was around 0.95 and dropped sharply over two Z units to 0.48 for very neutron-deficient products. This relative range behavior was used to analyze isobaric charge dispersion curves into three individual charge dispersion curves corresponding to two fission mechanisms (a low-excitation energy process, fission I, and a high-excitation energy process, fission II) and a nonfission (spallation) mechanism. The fractional isobaric cross section for the spallation process decreases with decreasing mass number from 0.98 at mass 170 to about 0.14 at mass 111 and then increases with decreasing mass number to 0.49 at mass 74. The products are neutron deficient, of low range, and with forward-to-backward recoil ratios (F/B) close to unity. The range

values increase almost linearly with ΔA (mass difference from the target nucleus) from 2.2 mg/cm² U at ΔA of 70 to 5.6 mg/cm² U at ΔA of 160. The value of $v_\parallel$, the velocity imparted to the target nucleus in the beam direction as a result of the intranuclear cascade, decreases from 0.04 (MeV/amu)$^{(1/2)}$ at δA of 70 to 0.01 (MeV/amu)$^{(1/2)}$ at ΔA of 100 and then increases to 0.02 (MeV/amu)$^{1/2}$ at ΔA of 160. The fractional isobaric cross section for the fission II process is roughly constant with a maximum value of 0.17 for mass number 131. The relative range values for these products are about 0.9 and the F/B values are also close to unity. (auth)

14283 MASS AND NUCLEAR CHARGE DISTRIBUTIONS FROM THE SPONTANEOUS FISSION OF ^{254}Fm. Harbour, R.M.; MacMurdo, K.W.; Troutner, D.E.; Hoehn, M.V. (Savannah River Laboratory, E. I. du Pont de Nemours and Company, Aiken, South Carolina 29801). Phys. Rev. C 8: No. 4, 1488-1493 (Oct 1973).

The relative fission yields of 20 mass chains from ^{254}Fm spontaneous fission were measured by direct high-resolution γ-ray spectroscopy of the gross fission products. Reflected yields were calculated based on a prompt-neutron fission yield of 3.94; the absolute yields were determined by requiring the sum of all yields to be 200%. A peak-to-valley ratio for the mass-yield of ⩾ 18 was determined radiochemically by measuring the cumulative yields of ^{140}Ba and ^{127}Sb. ^{254}Fm was produced by irradiating ^{253}Es in a high-flux reactor and then chemically separating the 3.24-h ^{254}Fm from its 39.3-h ^{254}Es parent. An aluminum "catcher" foil was used to collect the ^{254}Fm fission products. Nuclear charge distribution studies included measurements of the independent yields of ^{140}La, ^{135}Xe, ^{134}I, and ^{132}I relative to their cumulative yields from direct γ-ray-spectroscopy data. (auth)

14284 THERMAL NEUTRON FISSION CROSS-SECTION OF ^{227}Ac AND ^{227}Th. Del Marmol, P.; Hanappe, F.; Monsecour, M. (CEN, Mol, Belgium). J. Inorg. Nucl. Chem.; 35: No. 12, 4323-4325(Dec 1973).

An account is given of the measurement of σ_f of ^{227}Ac and of its radioactive daughter ^{227}Th. The chemical separation of the actinium from irradiated ^{226}Ra, and from its decay products, is described. The purified material, spread on a Ta plate, was irradiated in the BR1 reactor together with a fission track detector. The number of fission tracks were counted at various times after ^{227}Ac purification. From these results and from separate measurements for ^{227}Th, and taking into account possible sources of error, the thermal neutron fission cross-sections are found to be: $\sigma_f^{Ac} \leq 350$ μ barn; $\sigma_f^{Th} = 203 \pm 16$ barn. (UK)

14285 STUDY OF FISSION OF ^{233}U AND ^{235}U INDUCED BY THERMAL NEUTRONS. Zakharova, V. P.; Ryazanov, D. K.; Basova, B. G.; Rabinovich, A. D.; Korostylev, V. A. Yadern. Fiz.; 18: No. 4, 710-719(Oct 1973). (In Russian).

Yield of fission events, N, is studied as function of pair fragment energies E_1, E_2, at fission of ^{233}U and ^{235}U induced by thermal neutrons. The fragment energies were registered in a double ionization chamber with meshes. The peak/dip ratios in the mass distributions, not corrected by account of the resolution and the neutron emission, for ^{233}U and ^{235}U are found to have values, averaged over several series, of 300 and 350, respectively. The initial $N(E_1, E_2)$ distributions were transformed to $N(E_k, \mu)$ where μ is the fragment mass, obtained with no account of a neutron emission, and E_k is the total fragment kinetic energy. Sequences of the energy and mass spectra as functions of μ and E_k are presented. The shape of the energy spectra have some peculiarities: besides the main bumps there are some peaks of essentially less intensity. In the region of mass symmetry the mean energy of these peaks is 120–130 MeV, while in the region of strong asymmetry it is 170–180 MeV. The main bumps in the energy spectra are nonuniform and in some cases may be represented as superpositions of several more narrow components. This structure effect is still more manifested in the fragment mass spectra. Possible reasons of these phenomena are discussed. The basic properties of the energy distributions are compared with those by other authors. The maximum–minimum difference for E_k in the case of ^{235}U in the symmetric mass region is found to be 18 ± 2 MeV. (auth)

14286 ANGULAR AND KINEMATICAL CORRELATIONS OF α-PARTICLES AND NEUTRONS FROM TRIPLE FISSION OF ^{252}Cf NUCLEI. Graevskii, A. P.; Solyakin, G. E. (Leningrad Inst. of Nuclear Physics). Yadern. Fiz.; 18: No. 4, 720-723(Oct 1973). (In Russian).

Based on the experimental results on study of angular and energy spectra of neutrons from triple fission of ^{252}Cf a possibility is discussed to detect in this process nuclear unstable particles, in particular, ^{5}He and ^{6*}He in excited state. Assuming that the observed effect of the correlations is due completely to the decay of ^{6*}He, accelerated by the Coulomb field, into ^{4}He + 2n state, the authors conclude that the yield of ^{6*}He is 5% of the α-particle yield. (auth)

14287 MULTIPLICITY OF PROMPT NEUTRONS FROM SPONTANEOUS NUCLEAR FISSION. Dakovskii, M.; Lazarev, Yu. A.; Oganesyan, Yu. Ts. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 18: No. 4, 724-733(Oct 1973). (In Russian).

The distributions P_ν of the number of prompt neutrons produced in spontaneous fission of ^{244}Cm and ^{248}Cm are measured. The mean number of neutrons per fission event is obtained to be $\nu = 2.98 \pm 0.03$ for ^{248}Cm. For ^{244}C $\nu = 2.69 \pm 0.01$. The survey of the experimental data on the dispersion σ_ν^2 of the number of prompt neutrons produced in fission is given. The dependence of σ_ν^2 on Z, A and on the excitation energy of the fissionable nucleus is studied. It is suggested that σ_ν^2 and the yield of fragments are correlated in the symmetrical region of masses. (auth)

14288 NONOBSERVABILITY OF THE (n,γn′) PROCESS AT KEV NEUTRON ENERGIES. Moldauer, P. A. (Argonne National Lab., IL). Nucl. Sci. Eng.; 52: No. 4, 500-501(Dec 1973).

The cross section for the (n,γn′) process initiated by keV-energy neutrons incident on ^{238}U is estimated to be below the microbarn range. (auth)

14289 NUCLEAR FISSION. Vandenbosch, R.; Huizenga, J. R. New York; Academic Press, Inc. (1973). 432p. $29.50.

The object of the book is to provide a comprehensive account of present understanding of nuclear fission. While it is written at an introductory level for students of the physics and chemistry of fission, it also attempts to cover recent developments at a sufficient depth to make the volume valuable to research scientists. The theoretical framework is developed in a systematic way and discussed in terms of the most recent experimental observations. The scope of the book is indicated well by its chapter titles: Introduction, The fission barrier, Spontaneous fission, Fission widths from neutron resonance studies, Properties of low-lying levels of transition nuclei determined from reaction studies, Fission-fragment angular distributions at moderate to high excitation energies, Competition between fission and neutron emission, Fission barrier heights, Motion from saddle to scission: theories of mass and energy distributions, Kinetic energy release in fission, Distribution of mass and charge in fission, Prompt neutrons from fission, Gamma rays from primary fission products, and Ternary Fission. (222 figures, 41 tables, 626 references) (RWR)

14290 NUCLEAR CHARGE DISPERSION IN MASS CHAINS 130-135 FROM THE FISSION OF ^{238}U BY MEDIUM-ENERGY PROTONS. Diksic, M.; McMillan, D. K.; Yaffe, L. (McGill Univ., Montreal). J. Inorg. Nucl. Chem.; 36: No. 1, 7-16(Jan 1974).

Independent formation cross-sections of ^{131m}Te, ^{131g}Te, ^{130}I, ^{131}I, ^{132}I, ^{133}I, ^{134}I and ^{132}Cs, and cumulative formation cross-sections of ^{131}Sb, ^{132}Te, ^{133m}Te, ^{133g}Te, ^{134}Te and ^{135}I resulting from the fission of ^{238}U induced by protons of 30 to 85 MeV energy have been measured. From these data isobaric charge dispersion curves were constructed for mass chains A = 130 to 135 and were found to be well represented by Gaussian distributions. Within the mass region $130 < A < 135$ and proton energy range $30 < E_p < 85$ MeV, $Z_A - Z_p$ values for each mass chain approached stability with increasing energy and were independent of mass number. Values of Z_p varied smoothly but nonlinearly with proton energy. The derivative $(\partial Z_p/\partial A)_E$ was measured to be 0.38 ± 0.02, in good agreement with the assumption Z_p parallels Z_A. The charge dispersion widths were found to increase slightly with both increasing proton bombarding energy and mass number. Estimates of the number of neutrons emitted in fission as a function of average excitation energy were made using a Monte Carlo cascade model, the unchanged charge distribution (UCD) mechanism and the experimentally determined Z_p values from this study. (auth)

14291 ABSOLUTE (p,xn) CROSS-SECTION MEASUREMENTS ON ^{232}Th. Suk, H. C.; Crawford, J. E.; Moore, R. B. (McGill Univ., Montreal). Nucl. Phys.; A218: No. 2, 418-428(1974).

Excitation functions were measured for both the (p, 6n) and (p, 7n) reactions on ^{232}Th at incident energies up to 100 MeV using the external beam of the McGill synchrocyclotron. The natural activity of the target material is used to determine the target thickness, making it unnecessary to use monitor foils, or to carry out chemical separations following bombardment. The shape of both excitation functions is consistent with the prediction of the Jackson model. If fission competition is taken into account the observed cross sections are in reasonable quantitative agreement with the theoretical predictions. The (p, 6n) excitation function is found to be in disagreement with a number of earlier measurements. (auth)

14292 RANGES OF FRAGMENTS FROM THE SPONTANEOUS FISSION OF ^{252}Cf AND THE KINETIC ENERGY DEFICIT. Birguel, O.; Oelmez, L.; Aras, N. K. (Middle East Technical Univ., Ankara). Radiochim. Acta; 18: No. 4, 198-201(1973).

The recoil ranges of several fission products from spontaneous fission of ^{252}Cf were measured. The observed average ranges in mg Al/cm^2 are: ^{99}Mo, 3.85 ± 0.03; ^{105}Rh, 3.80 ± 0.13; ^{111}Ag, 3.64 ± 0.02; ^{113}Ag, 3.63 ± 0.02; ^{115}Cd, 3.63 ± 0.02; ^{127}Sb, 3.31 ± 0.05; ^{129}Sb, 3.32 ± 0.02; ^{131}I, 3.46 ± 0.03; ^{133}Te, 3.38 ± 0.02; ^{140}Ba, 3.03 ± 0.03. Ranges of the fragments were converted into energies in order to determine the amount of the deficit in the total kinetic energy release symmetric fission. The deficit was found to be 16 MeV. The relation between the amount of kinetic energy deficit and shell structure, and possible fine structure with masses A = 131 and 132 are discussed. (orig.) (GE)

14293 RELATIVE YIELDS OF SOME γ-RAY EMITTING NUCLIDES FROM THE THERMAL NEUTRON FISSION OF ^{235}U. Debertin, K. (Physikalisch–Technische Bundesanstalt, Brunswick). Radiochim. Acta; 18: No. 4, 202-206(1973).

Cumulative yields of some fission products from thermal neutron fission of ^{235}U were determined relative to each other by comparing the γ-ray spectrum of an irradiated fuel sample with the single spectra of standard sources of the same fission products. Special emphasis was given to the yields of the fission products ^{103}Ru, ^{131}I, and ^{141}Ce because the recommended values in various recent compilations differ by up to 5%. Assuming a value of 5.35% for the cumulative yield of ^{144}Ce one obtains 3.06% for ^{103}Ru, 2.91% for ^{131}I and 5.75% for ^{141}Ce with relative measurement uncertainties of about 2%. (orig.) (GE)

Nuclear Theory

Refer also to abstracts 13956, 14002, 14223, 14269–14271, 14289, and 14522.

14294 (BNL-18335, pp 185-199) WHAT CAN WE LEARN ABOUT NUCLEI BY STUDYING HYPERNUCLEI? Feshbach, H. (Massachusetts Inst. of Tech., Cambridge). 1973.

From conference on nuclear and hypernuclear physics with kaon beams; Upton, New York (2 Jul 1973).

In proceedings of the summer study meeting on nuclear and hypernuclear physics with kaon beams.

A study is made of what can be learned about nuclei and nuclear structure if all possible experimental information regarding hypernuclei were available. The lambda is considered to act as a probe. (JFP)

14295 (COO-2171-33) DISTRIBUTIONS, FLUCTUATIONS, AND SYMMETRIES IN MANY-PARTICLE SPECTROSCOPY. French, J. B. (Rochester Univ., N.Y. (USA). Dept. of Physics and Astronomy). 7 Sep 1973. Contract AT(11-1)-2171. 43p. (UR-454). Dep. NTIS $4.25.

The state density for a spectroscopic system of many interacting particles is determined to a large extent by the operation of a central limit theorem which fixes the averaged form, while, throughout the entire spectrum, the fluctuations about the average closely follow the laws, derived for high excitation energy, by considering random matrix ensembles. The fluctuations are small, the Dyson–Mehta description of the random ensemble spectra as "essentially crystalline" being found to apply much more generally. The same general results obtain, both for averages and fluctuations, under a restriction to states of given exact symmetry, and, for the averages, even for broken symmetries. Other properties of the system, occupancies for example, are determined similarly. (auth)

14296 (IAEA-153, pp 305-365) RESEARCH OF THE BEST RUNNING CONDITIONS OF NUCLEAR CODES FOR COUPLED CHANNEL CALCULATION OF NEUTRON INTERACTION WITH HEAVY DEFORMED NUCLEI. Kikuchi, Y. (CEN de Saclay, Gif-sur-Yvette, France). 1973.

From proceedings of a panel on neutron nuclear data evaluation; Vienna, Austria (30 Aug 1971).

The effects of various physical approximations in the coupled-channel optical model and the errors due to the uncertainty in the deformation parameters are examined. As for the shape of potential, the deformation of the imaginary potential must be considered, but the deformation of the spin–orbit-coupling potential can be neglected. The deformed potential should be expanded with Legendre polynomials at least up to λ = 4. When the energy of the incident neutron is less than 1 MeV, the coupling of 3 levels seems most reasonable except for inelastic scattering. The errors in cross sections are less than 3% with this condition. For calculating the inelastic scattering to the n-th state, the coupling to the (n + 1)-th state is required. If the neutron energy is higher than 1 MeV, the adiabatic approximation is highly recommended, because more precise results can be obtained with much less computing time. In the coupled-channel model, the contributions of high angular momentum, which are negligible in the spherical optical model, must be considered. The uncertainties of the deformation parameters cause considerable errors. The uncertainty in the β_2 value is ± 10%, and that in the β_4 value is a completely open question. Hence, the errors due to these uncertainties are inevitable, even if the errors due to the physical approximations can be removed. The errors are estimated to be 3% for the reaction and the elastic scattering cross sections, 5% for the strength functions, and 20% for the inelastic scattering cross sections. (11 figures, 13 tables) (auth)

14297 (IAEA-153, pp 367-393) COMPARISON OF SPHERICAL OPTICAL MODEL CODES AND STANDARD VALUES FOR NUCLEAR DATA EVALUATIONS. Kikuchi, Y. (CEN de Saclay, Gif-sur-Yvette, France). 1973.

From proceedings of a panel on neutron nuclear data evaluation; Vienna, Austria (30 Aug 1971).

In order to examine the reliability of the results calculated with different spherical optical-model codes and to find the best conditions of numerical integration, six codes (MAGALI, GENOA, KOUAC, ABACUS-2, JUPITOR, and ECIS 70) were compared with the same optical-model parameters for neutrons whose energies were 0.6, 4.75, and 14.1 MeV. The number of meshes in the numerical integration should be determined to optimize both truncation error and round-off error. The best value should fall between 100 and 200 for a code with single precision in IBM-360. An insufficient matching radius causes considerable errors (as in the case of GENOA). On the other hand, a slight difference of the physical constants used in the programme, such as the neutron mass and the conversion constant between energy and wave length, causes a fairly big error on the results (as in the case of ABACUS-2). After taking these conditions into consideration, it was found that the results of these six codes agree very well with each other. It seems very dangerous to use some code as a black box without careful examination about these conditions; hence, these present results are proposed as some standard values to check other codes. (3 figures, 7 tables) (auth)

14298 (IAEA-153, pp 395-401) COMPUTER CODES BASED ON STATISTICAL, OPTICAL AND DIRECT INTERACTION MODELS. Igarasi, S. 1973.

From proceedings of a panel on neutron nuclear data evaluation; Vienna, Austria (30 Aug 1971).

A brief introduction to computer codes used by JNDC (Japanese Nuclear Data Committee) that are based on statistical, optical, and direct interaction models is given. The following seven computer codes are presented: ELIESE-3, JUPITOR-1, TOTAL, RACY, STAF, TRANCE, and WAFFLE. The purposes of these codes are briefly described. For ELIESE-3 and JUPITOR-1, some problems are discussed concerning their applications. (auth)

14299 (IAEA-153, pp 403-416) NUCLEAR MODEL CODES USED BY THE CNEN NUCLEAR DATA GROUP. Benzi, V. (CNEN, Bologna). 1973.

From proceedings of a panel on neutron nuclear data evaluation; Vienna, Austria (30 Aug 1971).

A brief outline of nuclear model codes used by the Nuclear Data Group of the CNEN Computing Centre (Bologna) is provided. Some of the results obtained by using different codes, approximations, or computers are compared for several cases. (1 figure, 4 tables) (auth)

14300 (IAEA-153, pp 417-420) NOTES ON THE AVAILABILITY, QUALITY, AND COMPARISON OF NUCLEAR MODEL CODES. Benzi, V. (CNEN, Bologna). 1973.

From proceedings of a panel on neutron nuclear data evaluation; Vienna, Austria (30 Aug 1971).

A number of points which should be considered in examining the quality, availability, and comparison of computer codes used for the calculation of neutron cross sections are briefly set forth. (1 table) (auth)

14301 SERIAL STATISTICS: IS RADIOACTIVE DECAY RANDOM? Anderson, J. L.; Spangler, G. W. (Univ. of Tennessee, Chattanooga). J. Phys. Chem.; 77: No. 26, 3114-3121(20 Dec 1973).

Based on more than 10^8 counts obtained from γ emissions arising from ^{60}Co and ^{137}Cs nuclei, serial statistical tests—the sum of squares of 0,1 standardized slopes of linear regressions and the sum of squares of the closely related 0,1 standardized correlation coefficients—exhibit significant deviations from the theoretic (random) expectation as a function of differences in the source environment. On the other hand, more conventional, nonserial statistical tests—the χ-square goodness-of-fit and index of dispersion tests—derived from the same data are indistinguishable from those expected for random events. These

serial discrepancies raise a substantial question as to the randomness of the detected emissions and, insofar as emissions and decay events are appropriately interrelated, the independence of the events themselves. (auth)

14302 NUMBER–DISPLACEMENT DEGREES OF FREEDOM IN NUCLEAR ROTATIONAL THEORY. Rasmussen, J.O. (Lawrence Berkeley Laboratory, University of California, Berkeley, California, 94720); Ma, C.W. Phys. Rev. Lett. 31: No. 5, 317-319 (30 July 1973).

A new degree of freedom associated with shifting of particles between the even–parity–orbitals system and the odd–parity–orbitals system is introduced in the study of the nuclear rotational problem. It is found that this new mode contributes significantly to the deviation from the I(I+1) rule, with correction terms comparable to the Coriolis antipairing effect. (auth)

14303 MULTIPLE PRODUCTION ON NUCLEI. Zalewski, K. (Inst. of Nuclear Physics, Krakow). Acta Phys. Pol.; B4: No. 6, 973-978(1973).

The evidence for the unexpectedly high transparency of nuclei to newly produced particles, and the theoretical interpretations of this phenomenon are reviewed. (auth)

14304 UNIVERSALITY OF THE ANGULAR DISTRIBUTION FOR NUCLEAR ELASTIC SCATTERING AT INTERMEDIATE ENERGIES. Kohmura, T. (Tokyo Univ. of Education). Lett. Nuovo Cim.; 8: No. 16, 956-960(15 Dec 1973).

It is suggested from a survey of experimental data on angular distributions of nuclear elastic scattering at intermediate energies that the scattering must be insensitive to details of nuclei and may be described by a simple geometrical theory. A description of high-energy scattering is obtained, following the partial-wave formalism, and an expression is given for the differential cross section for elastic scattering plotted vs. q^2. The formalism reproduces in fair agreement the universal features of the angular distribution. (auth)

14305 MASS ASYMMETRY IN FISSION AND NUCLEAR VISCOSITY. Pwu, C. L.; Castel, B. (Queen's Univ., Kingston, Ont.). Lett. Nuovo Cim.; 8: No. 16, 945-950(15 Dec 1973).

A simple approach to the dynamic description of the fission process is proposed. Nuclear viscosity is introduced to link the particle excitation to the classical energy dissipation in a fluid model. The mass-asymmetry ratio is then derived for different nuclear temperatures and compared with experiment. (auth)

14306 CORRELATION EFFECTS IN NUCLEAR DENSITIES. Strayer, M.R. (Institut de Physique Nucleaire, Division de Physique Theorique, 91–Orsay, France); Bassichis, W.H.; Kerman, A.K. Phys. Rev. C 8: No. 4, 1269-1274 (Oct 1973).

Corrections to nuclear densities arising from static short–range correlations are evaluated for the nuclei ^{16}O, ^{40}Ca, and ^{56}Ni. The corrections are calculated using Rayleigh–Schrödinger perturbation theory in a basis obtained using Hartree–Fock. All corrections which are second order in the interaction are treated. The effects of necessary truncations are studied and are shown to render the results uncertain by about 20%. The net change in the density is a radial function which is less than 6% of the Hartree–Fock density and which oscillates in such a way that its effect on the rms radius is negligible. It is pointed out that in Brueckner–Hartree–Fock calculations a certain lack of cancellation might result in an excessively large change in the density and radius. (auth)

14307 ANISOTROPIC ELASTIC SCATTERING AND MOVING MEDIA. Wienke, B. R. (Los Alamos Scientific Lab., NM). Nucl. Sci. Eng.; 52: No. 4, 482-484(Dec 1973).

Classical anisotropic scattering in the laboratory is examined for a moving-target medium. Legendre expansions of the scattering probability function f(v',v) are given in the physical region for the general case of anisotropic elastic scattering in the center-of-mass system, and the low-order expansion coefficients are listed. The effects of a moving medium are also studied in the angle transformation from center-of-mass to laboratory system, and kinematical constraints linking angles, masses, and particle and material speeds are listed. (1 figure) (auth)

14308 CONSERVATION DURING DOPPLER BROADENING. Cullen, D. E. (Lawrence Livermore Lab., CA). Nucl. Sci. Eng.; 52: No. 4, 498-500(Dec 1973).

Conservation under Doppler broadening is examined. It is shown that the area under the cross-section curve is not conserved and that the only conservation law associated with Doppler broadening is the integral of the reaction rate over all phase space. (auth)

14309 INTERNAL EXCITATION AND IONIZATION ACCOMPANYING K CAPTURE. Mukoyama, T.; Isozumi, Y.; Kitahara, T.; Shimizu, S. (Institute for Chemical Research and Radioisotope Research Center, Kyoto University, Kyoto, Japan). Phys. Rev. C 8: No. 4, 1308-1318 (Oct 1973).

The internal excitation and ionization probabilities during K–electron capture have been treated relativistically by the use of hydrogenic wave functions. Relativistic and nonrelativistic calculations for the double K–hole production probability, the total internal ionization probability, and the energy spectrum of the ejected electrons are presented. The present calculations show that the relativistic effects cause a substantial reduction in the probabilities. The calculated probabilities of the double K–hole production and the total internal ionization have been compared with the experimental values, and there has been fairly good agreement between the calculated and the recently measured values. The spectral shape of the ejected electrons calculated from the present relativistic theory is similar to that obtained from the previous nonrelativistic and relativistic theories. The theoretical curves are in good agreement with the experimental results in the high–energy region. The discrepancies between the theory and the various experiments are discussed and further work is suggested. (auth)

14310 NEUTRON POLARIZATION IN ISOSPIN–FORBIDDEN (p, n) REACTIONS. Monahan, J.E.; Elwyn, A.J. (Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. C 8: No. 4, 1339-1346 (Oct 1973).

It is shown that the angular distributions of the yield and of the polarization of neutrons in isospin–forbidden (p, n) reactions can provide a test of the statistical assumptions that are usually made in the analysis of isobaric–analog– resonance reactions. Also, under certain specified conditions, such measurements can detect any significant neutron width acquired by the analog state via Coulomb mixing with the $T_<$ background states. Recent measurements of the yield and polarization for the $^{51}V(p, n)^{51}Cr$ reaction in the neighborhood of the analog resonance observed at a proton energy of ≈2.335 MeV are discussed in terms of the present results. However, this particular example provides no unambiguous information about the mechanism that causes a breakdown of the statistical model or about a possible enhancement of the neutron width in the vicinity of the analog. (auth)

14311 REALISTIC PARTIAL STATE DENSITIES FOR PROTON–NEUTRON CONFIGURATIONS IN NUCLEI NEAR CLOSED SHELLS. Albrecht, K.; Blann, M. (Department of Chemistry, and Nuclear Structure Research Laboratory, University of Rochester, Rochester, New York 14627). Phys. Rev. C 8: No. 4, 1481-1487 (Oct 1973).

Using Nilsson single–particle level schemes as input, we have calculated partial state densities for excited proton–neutron configurations with specified particle–hole numbers. The recursion relation method used is general and free of any mathematical approximations. Results are given for nuclides in the Sn region and for several Pb isotopes. The strong shell effects in these nuclei are clearly reflected in their state densities. The results are compared to densities obtained from the equidistant–spacing model. This model not only fails completely at low excitation energies as expected, but it also disagrees in several cases with the average behavior of the realistic densities at higher energies. (auth)

14312 GROUND-STATE CORRELATIONS FOR N ≠ Z NUCLEI. Parikh, J.K. (Atomic Minerals Division, N. P. L. Building, Hillside Road, New Delhi, 110012, India). Phys. Rev. C 8: No. 4, 1433-1437 (Oct 1973).

The method of calculating ground–state correlations in the random–phase approximation (RPA) has been extended for N ≠ Z nuclei. The expressions for the single–particle densities and RPA equations are derived. An application of this method could be made in explaining the anomalous isotope shift in the charge radii of ^{46}Ca–^{48}Ca. (auth)

14313 BOSON–EXPANSION METHOD AND THE COLLECTIVE NEGATIVE–PARITY STATES IN EVEN–EVEN SPHERICAL NUCLEI. Rădută, A.A.; Ceausescu, V.; Stratan, G.; Săndulescu, A. (Institute for Atomic Physics, Bucharest, P.O.B. 35, Romania). Phys. Rev. C 8: No. 4, 1525-1538 (Oct 1973).

Based on the conventional shell–model Hamiltonian with pairing, quadrupole, and octupole effective forces, the quadrupole–octupole collective anharmonicities are studied by the boson–expansion method. The Belyaev–Zelevinski expansion convergence is improved by supplementing it with a canonical transformation of the random–phase–approximation phonons, determined from the minimum condition for the ground–state energy. Calculations for the one level case show that the anharmonic terms corresponding to the new representation are much smaller than the harmonic–like terms. Explicit expressions for the first 2^+, 3^-, and quintuplet (1^-,2^-,3^-,4^-,5^-) energies and wave functions as well as for B(E2) ($2^+ \rightarrow 0^+$) and B(E3) ($3^- \rightarrow 0^+$ and $3^{-\prime} \rightarrow 0^+$) are derived by a perturbation treatment. The quintet ordering predicted by the previous calculation is reproduced by a rough estimation. Also, expressions for the static quadrupole moments of the first 2^+ and 3^- states are given. (auth)

14314 MESONIC SECOND-CLASS CURRENTS IN NUCLEAR β DECAY. Eman, B.; Guberina, B.; Tadic, D. (Institute "Rudjer Bošković" and Faculty of Science, Zagreb, Croatia, Yugoslavia). Phys. Rev. C 8: No. 4, 1301-1307 (Oct 1973).

Mesonic second-class currents have been studied in semileptonic $\Delta S = 0$ transitions. The closed-loop diagram is finite for the $\pi\omega$ current, and its energy-dependent lepton part is dominant over the contributions from the two-body exchange diagram. The two-body exchange diagram has energy-dependent and energy-independent lepton parts, which are of comparable magnitude for the A = 12 triplet. A general form of the mesonic current has also been considered. A general theory of second-class effects, including both mesonic currents and the induced-tensor term for ft values and K/β^+ ratios, has been discussed. (auth)

14315 ELECTROMAGNETIC POTENTIAL BETWEEN NUCLEONS. Kiang, D. (Dalhousie Univ., Halifax, N. S.); Machida, S.; Nogami, Y. Can. J. Phys.; 51: No. 10, 1120-1122(15 May 1973).

Some confusion concerning the electromagnetic potential between two nucleons when their finite size is taken into account is clarified. (auth)

14316 SECOND-CLASS CURRENT PROBLEM IN NUCLEAR BETA DECAY. Kubodera, K.; Delorme, J.; Rho, M. (CEN de Saclay, Gif-sur-Yvette, France). Nucl. Phys.; B66: 253-292 (1973).

Taking into account in a simple but non-trivial way both off-mass-shell and meson-exchange effects, the second-class current (scc) contribution to asymmetries in nuclear mirror Gamow-Teller decays is calculated. No assumptions on the divergence of the scc are made but the previous result obtained for a divergenceless current is recovered straightforwardly from our formula. Of the plethora of parameters that can be brought in for a current with non-vanishing divergence, only the minimum number (two) which still renders the calculation sufficiently realistic while retaining its predictive power is considered. The two parameters—one associated with the off-shell phenomenon and the other with the meson-exchange current—are determined from the two pieces of experimental data on the A = 8 system (the averaged asymmetry $\bar{\delta}$ obtainable from the total decay rates and the slope in the plot of δ versus the energy release) and predictions are made for the scc effects in other mirror transitions. On the average the expected scc contribution to mirror asymmetry δ is 2 to 5%, for both even- and odd-A nuclei. The same conclusion as Wilkinson is reached that the large residual asymmetry ($\gtrsim$10%) left unaccounted in odd-A nuclei must be nuclear in origin. The fundamental nucleon pseudotensor coupling constant implied by this result is still of the same order ($\sim 1/M$, where M is nucleon mass) as that of the weak magnetism or pseudoscalar terms. In the absence of kinematic suppression, this could induce large effects. Thus the ω-decay into $\pi^+e^-\nu$ is expected to be as fast as any allowed first-class decay of a meson with comparable mass. The asymmetries in various correlation experiments (i.e., $e\nu$ correlation and up-down asymmetry with respect to nuclear spin polarization) are predicted to be large enough to be measurable. A detailed analysis is made on whether, as conjectured by Lipkin, the meson-exchange current can build up coherently for large nuclei. The conclusion drawn therefrom is that such an enhancement does not materialize. (auth)

14317 CORRECTIONS TO THE CLOSURE APPROXIMATION FOR THE OPTICAL POTENTIAL. Koch, J. H. (Stanford Univ., CA). Nucl. Phys.; B66: 464-481(1973).

Target closure is a basic assumption made at the outset of many derivations of the standard optical potential. Using the formalism of Foldy and Walecka it is shown how the target dynamics, neglected in the closure approximation, can be incorporated into the scattering amplitude and the optical potential. To illustrate this procedure and to examine the nature of the nuclear effects, the leading correction to the closure approximation evaluating by using a Fermi gas model for the nucleus. This simple picture is known to reproduce the major part of the nuclear response surface as observed in inelastic electron scattering. (auth)

14318 SHELL EFFECTS IN EXCITED FISSIBLE NUCLEUS. Adeev, G. D.; Cherdantsev, P. A. (Tomsk Polytechnical Inst., USSR). Yadern. Fiz.; 18: No. 4, 741-750(Oct 1973). (In Russian).

Disappearance of shell effects in the energy and the level density for composite fissible nuclei, resulting from heating, is considered. The shell effect disappears at the excitation energies of about 60–80 MeV. It is shown that only at high excitation energies the Fermi-gas model with the effective excitation energy, counted from the liquid-drop energy surface, may be used to describe the density of excited states. The excitation energy dependence of the peak/dip ratio in the mass distribution of fission fragments is calculated for ^{232}Th and ^{236}U. (auth)

14319 EQUATIONS FOR ONE- AND TWO-PARTICLE DENSITY MATRICES IN GREEN'S FUNCTION METHOD. Comparison With the Random Phase Approximation. Kamerdzhiev, S. P. Yadern. Fiz.; 18: No. 4, 751-761(Oct 1973). (In Russian).

Green's function method is applied to the description of nuclear levels–superposition of the 1p1h and 2p2h configurations. Irreducible amplitudes for the transitions 1p1h → 1p1h, 1p1h → 2p2h, 2p2h → 1p1h, 2p2h → 2p2h are introduced to obtain the exact equations for eigenfunctions and eigenvalues of the problem. The renormalization of the equations made it possible to consider all the processes near the Fermi level using the phenomenological effective amplitudes of quasiparticle interaction. The comparison is made with the generalized random-phase method. The approximations are discussed leading in the Green's function method to the equations for one- and two-particle density matrices as the equations obtained in the random–phase approximation. (auth)

14320 EFFECT OF THE CORIOLIS FORCE ON E1 TRANSITIONS BETWEEN ROTATIONAL BANDS. Baznat, M. I.; Pyatov, N. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 18: No. 4, 762-767(Oct 1973). (In Russian).

Effect of the Coriolis mixing on the E1-transition probabilities is considered in framework of the nonadiabatic rotational model. Numerical calculations are performed for some nuclei in the rare-earth region; the E1 transitions with $\Delta K = 1$ and 0 are also analyzed. (auth)

14321 MICROSCOPIC ANALOG OF THE COLLECTIVE BOHR–MOTTELSON MODEL. Vanagas, V. V.; Kalinauskas, R. K. (Inst. of Physics and Mathematics, Vilnyus, USSR). Yadern. Fiz.; 18: No. 4, 768-778(Oct 1973). (In Russian).

The collective and internal variables of the nucleus are described on the basis of the theory of the induced representations. The method is proposed for the projection of the collective part of the arbitrary nuclear wave function. The internal function is shown to have the most simple form if and only if the nuclear wave function is characterized by a definite O(n–1)-irreducible representation (n–number of nucleons). The irreducible properties as well as the construction method of the internal and collective wave function are investigated on the basis of the factorization formula of the fractional–parentage coefficients for the scheme U(3(n–1)). The microscopic analogue of the collective Bohr–Mottelson model Hamiltonian is proposed by averaging an arbitrary nuclear Hamiltonian on the internal nuclear wave functions as a basis. (auth)

14322 METHOD FOR REDUCING BREMSSTRAHLUNG-PRODUCED PHOTONEUTRON SPECTRA TO PARTIAL (γ,n) CROSS SECTIONS. Mecca, S. J. (Providence Coll.); Yergin, P. F. J. Comput. Phys.; 13: No. 3, 338-347(Nov 1973).

A new procedure is presented for reducing a series of bremsstrahlung-produced photoneutron spectra to partial (γ,n) cross sections to various possible states of the residual nucleus. The essentially new features of the method consist of the minor one of using linear interpolation to bridge gaps across regions where the cross sections cannot be calculated uniquely from the data, and the major one of requiring that the final computed partial cross section curves exhaust the entire yield spectra, not just the parts near the "tip" region which are usually used. The initially computed (and interpolated) "exact" cross sections are used to establish branching ratios to the various final states, which are held fixed in a fitting or normalization procedure. The method has the advantage that it permits reasonably good estimates of cross sections without requiring the large amount of data-taking the more conventional analysis would require, and it makes full use of the whole extent of the spectrum curves measured. The method is illustrated, and tested to a limited degree, by assuming cross sections for a fictitious nucleus Hy^A. Suggestions for improvements of the method are also presented. The general procedure may be useful in analysis of data from experiments other than photoneutron reactions, especially those where the effective resolution is as unfavorable as it is where the bremsstrahlung photon spectrum is the controlling factor. (auth)

14323 POISSON AND NON-POISSON BEHAVIOR OF RADIOACTIVE SYSTEMS. Frigerio, N. A. (Argonne National Lab., IL). Nucl. Instrum. Methods; 114: No. 1, 175-177(1974).

Recent reports that radioactive count rates did not follow Poisson statistics, even after conventional dead-time corrections, were confirmed for dead-times ≥ 0.8 μsec. However, excellent agreement was obtained with Brockwell–Moyal statistics, and these are suggested for accurate dead-time corrections. (1 figure, 1 table) (auth)

14324 DECAY OF PREPARED STATE TREATED AS A DOORWAY PHENOMENON. Huefner, J. (Max-Planck-Institut fuer Kernphysik, Heidelberg); Sevgen, A. Nucl. Phys.; A218: No. 2, 239-248(1974).

A doorway state phenomenon is considered: Via a selective process, like γ-decay, a highly excited nuclear state of simple structure is prepared. Its decay is investigated with particular emphasis on the compound nucleus modes. The formulas may be applied to radiationless decays in muonic atoms or to the decay of the residual nucleus after a (e,e'p) or (p,2p) reaction. (auth)

14325 APPLICATION OF INFINITE OSCILLATOR SHELL MODEL CALCULATIONS TO THE DESCRIPTION OF NUCLEAR REACTIONS. Ayad, A. A.; Rowe, D. J. (Univ. of Toronto). Nucl. Phys.; A218: No. 2, 307-323(1974).

A simple R-matrix procedure is proposed to provide a means of using nuclear structure information, from calculations in an infinite oscillator well, to describe reaction cross sections. The procedure uses values for the channel radius parameters of the R-matrix theory that are extracted from knowledge of the structure and reaction properties of the neighboring closed shell nucleus answering one of the main criticisms expressed concerning the dependence of the R-matrix on unphysical parameters. Application of the model to the scattering of neutrons from ^{15}N and comparison to previous theoretical predictions are considered. (auth)

PHYSICS (PLASMA AND THERMONUCLEAR)

14326 PLASMA PHYSICS INDEX. Volume 8, No. 11, 1973. Bibliography, Author Index, Subject Index. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1973). 169p.

Confinement and Heating

Refer also to abstracts 13724, 14403, 14409, 14439, 14440, 14453, and 14465.

14327 (LPS-130) APPLICATION OF INTENSE RELATIVISTIC ELECTRON BEAMS TO CONTROLLED THERMONUCLEAR FUSION RESEARCH. Sudan, R. N. (Cornell Univ., Ithaca, N. Y. (USA). Lab. of Plasma Studies). Jul 1973. Contract AT(11-1)-3170. 17p. (CONF-730705-26). Dep. NTIS $3.00.

From sixth European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973).

The use of electron beams for heating plasmas to thermonuclear temperatures is discussed with respect to the following: two-stream instability heating, return current heating, tokamak heating, and dense plasma heating. Focusing problems and instabilities are also briefly discussed. (MOW)

14328 (NP-19897) ANNUAL REPORT, 1972. (Max-Planck-Institut fuer Plasmaphysik, Garching/Munich (F. R. Germany)). [nd]. 313p. (In German). Dep. NTIS (U. S. Sales Only) $17.75.

Research during this period dealt mainly with the following areas: (1) ISAR devices, (2) belt pinch, (3) W Stellarators, (4) Pulsator, (5) rf heating, neutral beam injection, (6) MHD generators, (7) laser experiments, (8) relativistic plasmas, (9) fusion reactor technology, and (10) basic plasma physics. (MOW)

14329 (UCRL-75023) SOLVING PROBLEMS OF NEUTRAL-BEAM INJECTORS AT LLL. Chargin, A. K.; Anderson, C. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 Aug 1973. 9p. (CONF-731114-29). Dep. NTIS $3.00.

From 5th symposium on engineering problems of fusion research; Princeton, New Jersey, USA (6 Nov 1973).

Both mirror machines at LLL, Baseball II and 2XII, require neutral-beam injection of hydrogen or deuterium into the plasma. The neutral-beam injector components and their function in the injector system are outlined. Some of the problems with the ion sources, neutralizers, magnetic shielding, beam burial, and vacuum pumping are discussed. (auth)

14330 COUPLING TO THE LOWER-HYBRID RESONANCE. Puri, S.; Tutter, M. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Z. Naturforsch; 28a: No. 9, 1432-1442 (1973).

Transmission coefficient of a plane electromagnetic wave into a cold, inhomogeneous, magnetized, deuterium plasma half-space and its eventual absorption at the lower-hybrid layer is computed numerically for a wide range of parameters. It is found that TM (transverse magnetic) waves incident at small angles with the vacuum–plasma interface couple into the plasma provided that ω/ω_{ci} < approximately 20. Assuming that coupling to the lower-hybrid resonance in the cold-plasma approximation is an indication of accessibility to the ion-cyclotron-harmonic waves in the hot-plasma case, an alternative statement of the results obtained is that efficient coupling is possible from the second till the twentieth harmonic of the ion gyrofrequency using an antenna that launches TM waves at an approximately grazing incidence on the plasma surface. The most important contribution of this work is the suggestion of simple configurations for coupling rf energy into thermonuclear plasmas. (GE)

14331 HEATING OF UNDERDENSE PLASMAS BY INTENSE LASERS. Kruer, W.L. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). Phys. Fluids 16: No. 9, 1548-1550 (Sept 1973).

It is shown that intense lasers with frequencies (ω_0) much greater than the electron plasma frequency (ω_{pe}) will drive instabilities even in the electrostatic limit. (auth)

14332 TRAPPED ION INSTABILITY IN PLASMAS WITH MAGNETIC SHEAR. Gladd, N.T.; Ross, D.W. (Center for Plasma Physics and Thermonuclear Research, University of Texas at Austin, Austin, Texas 78712). Phys. Fluids 16: No. 10, 1706-1718 (Oct 1973).

The radial structure of the dissipative trapped ion mode is studied in order to determine the effect of shear and the possibility of finding ranges of tokamak operation which are stable to this mode even in the presence of a temperature gradient. It is found that owing to the presence of increasing numbers of resonant untrapped ions near the mode rational surfaces, where lq is an integer, the radial wavelengths are reduced and the modes are strongly Landau damped. These effects increase with increasing shear and with increasing values of l, the toroidal mode number. Numerical estimates of the growth rates and marginal stability conditions are obtained from eigenmode solutions of the radial differential equation and from algebraic dispersion relations which simulate the effects of the radial structure. It is concluded that if (r/q) dq/dr exceeds one, then the temperature threshold for instability is raised by approximately a factor of two from that of the no shear case. It is also proposed that even in unstable regimes, the anomalous diffusion should be less than indicated by previous estimates, since both the growth rates and wavelengths are reduced. (auth)

14333 DIFFUSION IN ELECTRON CYCLOTRON RESONANCE HEATING MAGNETIC MIRRORS. Lichtenberg, A.J.; Melin, G. (Association Euratom-CEA, Département de Physique du Plasma et de la Fusion Contrôlée, Centre d'Etudes Nucléaires, 38 Grenoble, France). Phys. Fluids 16: No. 10, 1660-1667 (Oct 1973).

A theory of electron cyclotron resonance heating in a mirror device is applied to the radio frequency induced particle diffusion into the loss cone. It is shown that the loss time is much slower than the heating time within the stochastic heating region, but that the losses are strongly enhanced over collisional losses alone. The effects of collisions in combination with the electron cyclotron resonance heating are considered and found to give additional heating beyond the adiabatic barrier, on the time scale of the 90 ° collisional deflection. The collisions also act, together with the radio frequency fields, to enhance the rate of loss cone diffusion. The major assumptions and results of the theory are confirmed by exact numerical calculations. Predictions of the performance of a 25 kW electron cyclotron resonance heating experiment are made. (auth)

14334 OBSERVATION OF NEOCLASSICAL DIFFUSION EFFECTS ON PLASMA LOSSES PRODUCED BY MAGNETIC FIELD ASYMMETRIES. Meade, D.M.; Fonck, R.J. (Physics Department, University of Wisconsin, Madison, Wisconsin 53706). Phys. Fluids 16: No. 10, 1654-1659 (Oct 1973).

Cross field loss of a partially ionized plasma induced by magnetic field asymmetries varies as the reciprocal of the collision frequency, ν, at large ν and as ν at small collision frequencies. The value of the collision frequency at peak loss (≈ 40 times classical for 1% field asymmetries) is a function of the asymmetry amplitude and wavelength. These observations can be accounted for in terms of an ambipolar neoclassical diffusion model taking into account field asymmetries in a shearless multipole-like device. (auth)

14335 PARAMETRIC DECAY NEAR THE LOWER-HYBRID RESONANCE. Fidone, I. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). Phys. Fluids 16: No. 9, 1544-1546 (Sept 1973).

Spatial parametric decay of a wave with frequency near the lower-hybrid frequency is investigated. A three-wave problem is considered with special emphasis on the effect of the mismatch of the wave vectors on the saturation amplitude of the excited waves and the characteristic length of conversion. (auth)

14336 PLASMA LOSSES TO AN OCTUPOLE HOOP. Drake, J.R. (University of Wisconsin, Madison, Wisconsin 53706). Phys. Fluids 16: No. 9, 1554-1555 (Sept 1973).

Plasma losses to the unsupported hoops of a toroidal octupole magnetic field were experimentally measured with striped, particle collectors and found to be 5 to 100 times smaller than calculated Bohm diffusion fluxes. (auth)

14337 STATIONARY POTENTIAL WELL FOR PLASMA IONS. Morozov, A. I.; Zhukov, V. V. JETP Lett. (USSR) (Engl. Transl.); 18: No. 6, 219-221(20 Sep 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 6, 373-376(20 Sep 1973).

It is shown experimentally that a stationary "potential well" can be produced for the ions of a plasma produced in crossed axially symmetric electric and magnetic fields of "mirror" geometry with a stabilizing magnetic field of opposite sign. The well "depth" reaches −700 V, or as much as 60 to 65% of the applied voltage.

Diagnostics

Refer also to abstracts 14364 and 14401.

14338 (CONF-731114-34) LOW-NOISE COLLECTION SYSTEM FOR THE THOMSON SCATTERING DIAGNOSTIC

APPARATUS ON ORMAK. Dyer, G. R.; Murakami, M. (Oak Ridge National Lab., Tenn. (USA)). 1973. 9p. Dep. NTIS $3.00.

From 5th symposium on engineering problems of fusion research; Princeton, New Jersey, USA (6 Nov 1973).

An automated data collection system as designed and built for the ORMAK Thomson scattering apparatus is described. The system uses both gated photomultipliers and gated integrators; advantages of this approach are discussed. Four electron-temperature and electron-density measurements can be made during each plasma discharge, with measurements spaced as closely as 1 ms apart. Data are automatically digitized and stored in a computer for processing and display. (auth)

14339 (EP-RR-32, pp 116-152) FUTURE OF THOMSON SCATTERING AS A PLASMA DIAGNOSTIC TECHNIQUE. Falconer, I. S.; Niland, R. A.; Smith, W.I.B. (Univ. of Sydney). Oct 1972.

From plasma physics seminar-1972 meeting; Canberra, Australia (9 Mar 1972).

Achievements at the Wills Plasma Physics Department in the measurement of plasma electron temperatures and densities from the Thomson scattering of ruby laser radiation are described, and a discussion is given of how the range of these parameters that can be measured may be extended in the future. The possibility of using wavelengths other than the ruby laser wavelength are explored, and the difficulties involved in observing effects associated with plasma resonances are discussed. (auth)

14340 (EP-RR-32, pp 153-169) DATA ACQUISITION AND HANDLING FOR PLASMA PHYSICS. Vance, C. F. (Australian National Univ., Canberra). Oct 1972.

From plasma physics seminar-1972 meeting; Canberra, Australia (9 Mar 1972).

Modern views of scientific research, as the formulation of hypotheses and of experiments whose results could disprove them, are summarized. Effective research demands the speedy confrontation of data produced by theory and by experiment. To the extent that one of these sources produces more data than is quickly available from the other for comparison, one accumulates archives of "dormant" data, which soon become "dead" data if not used. Plasma physics, involving interactions between many rapidly changing variables, raises such data mis-match problems. The solution depends on the provision of greatly improved mechanized aids to research. Some data acquisition and retrieval methods, and possible computing facilities with on-line interactive displays are outlined. These could be linked together to enable the physicist to compare theoretical predictions with experimental results much more effectively than is at present possible. (auth)

14341 (IPP-R-6) DATA ACQUISITION WITH DELTA 70. Schneider, J.; Wunderlich, R. (Max-Planck-Institut fuer Plasmaphysik, Garching/Munich (F. R. Germany)). Sep 1973. 9p. (In German). (IPP-1-135). Dep. NTIS (U. S. Sales Only) $3.00.

Data measured in plasma experiments have to be digitized for processing in computers. A few digitizing methods are discussed. Particular attention is devoted to the design and operation of the DELTA 70 system, with which oscillograms can be digitized. The experience gained with this system is described, and further possibilities of extension are mentioned. (auth)

14342 (SU-IPR-499) COMPUTER SIMULATION OF A SPHERICAL LANGMUIR PROBE. Albers, N. (Stanford Univ., Calif. (USA). Inst. for Plasma Research). Aug 1973. Contract AT(04-3)-799. 24p. Dep. NTIS $3.25.

A computer simulation is presented of a plasma–probe system containing many dynamical particles, represented as spherical shells of finite charge and mass with fixed angular momentum. These particles are injected with Maxwellian velocity distributions from a radius outside the plasma sheath, the latter being the region extending several Debye lengths out from the probe in which a space charge builds up to neutralize the probe's potential field. The current collected by the completely absorbing probe is determined as a function of the probe radius, measured in electron Debye lengths, and the probe potential with respect to the unperturbed plasma potential. Such a model allows the inclusion of trapped particles and has yielded some indication that their effect is to increase current collection, rather than decrease it as predicted. In the region where there are no potential mimima, the data match precisely those predicted. (auth)

14343 (UCRL-74942) 2°K VACUUM PUMPING SYSTEM FOR BASEBALL II. Denhoy, B. S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 Aug 1973. 7p. (CONF-731114-31). Dep. NTIS $3.00.

From fifth symposium on engineering problems of fusion research; Princeton, New Jersey, USA (6 Nov 1973).

A vacuum pumping system that provides a cryo surface for condensing and freezing of H_2 gas is described. A closed-loop vacuum system was designed and built at Lawrence Livermore Laboratory to pump down the neutralizer LH_e dewar with a volume of 350 l and the lambda point dewar with a LH_e volume of 250 l. Both of these dewars can be pumped down simultaneously or one at a time. 100% of the H_e gas is recovered free of contaminations. The vacuum pump can handle 340 SCFM of gas. The LH_e dewars are pumped down below the lambda point. This condition reduces the LH_e container wall temperature to 2.1°K giving a base pressure of 10^{-13} torr for H_2 gas[2]. To attain a stable condition the LH_e baths are pumped down to 33 torr or lower to give a surface temperature of about 2°K[3]. The Baseball II helium facility is a close loop system. The H_e gas is recovered from all the LH_e usage point. This gas is accumulated in one of the two 8000 cu ft inflatable gas bags. The gas from the gas bags is compressed into storage tanks at 1800 psig. The gas is purified to 99.99999% and it is liquified at a rate of 100 liquid liters per hour. (auth)

14344 DETERMINATION OF ELECTRON TEMPERATURE OF A PLASMA BY PROBING THE EXTRAORDINARY WAVE ALONG A MAGNETIC FIELD. Bredikhin, M.Y.; Mualov, A.I.; Skibenko, A.I.; Skibenko, E.I.; Fomin, I.P.; Yuferov, V.B. (Institute of Technical Physics, Academy of Sciences of the USSR). High Temp. 10: No. 6, 1068-1073 (July 1973).

This paper examines the possibility of determining the temperature of a plasma by probing the extraordinary wave, with the probing field frequency less than the electron cyclotron frequency and with electron concentration above critical. The absorption coefficient of this kind of plasma, which is transparent only for the extraordinary wave, depends appreciably on the magnetic field intensity. This makes it possible to determine the effective collision frequency from the relative change in the wave amplitude for a small variation in the magnetic field. The region of variation is chosen so that collisional absorption dominates over other kinds. Experimental investigations have been performed for $\lambda=3$ cm and $H=4$ to 10 kG. The observed values of temperature are compared with results of diamagnetic measurements. (auth)

14345 HOLOGRAPHIC INVESTIGATION OF ELECTRICAL EXPLOSIONS OF CONDUCTORS. Antonov, E.A.; Gnatyuk, L.N.; Stepanov, B.M.; Filenko, Y.I.; Tsarfin, V.Y. (Moscow). High Temp. 10: No. 6, 1087-1091 (July 1973).

Holography was used to study various stages of the explosions of wires in water and air. Estimates were obtained of the fragment velocity, the shock wave velocity, and the electron density in the resultant plasma. The advantages of the holographic method over photography were identified. (auth)

14346 INFRARED PLASMA DIAGNOSTIC METHODS. Soloukhin, R.I.; Yakobi, Y.A. (Institute of Theoretical and Applied Mechanics, Siberian Branch, Academy of Sciences of the USSR). High Temp. 10: No. 6, 1176-1181 (July 1973).

A brief review of new methods for measuring plasma parameters with CO_2 lasers is presented. (auth)

14347 MEASUREMENT OF THE TEMPERATURE OF A NONUNIFORM RADIATION SOURCE BY THE INVERSION METHOD. Nefedov, A.P. (Institute of High Temperatures, Academy of Sciences of the USSR, Moscow). High Temp. 10: No. 6, 1185-1186 (July 1973).

The temperature measurement of a plasma flowing through a channel is discussed. The temperature of the walls of the channel is generally below that of the flow core, and the temperature field differs according to the direction of observation. Diagram showing observed and actual core temperatures is described. (MOW)

14348 ADMITTANCE OF A SPHERICAL PROBE IN A WARM ELECTRON–ION PLASMA. Homonick, B.; Balmain, K. G. (Univ. of Toronto). Can. J. Phys.; 51: No. 5, 513-517(1 Mar 1973).

Two-fluid, scalar-pressure theory with an absorptive boundary condition is used to calculate the input admittance of a spherical probe in a warm electron–ion plasma. In addition to the usual resonances at the electron plasma frequency and at the sheath-plasma "series resonance" frequency, the theory predicts a rather broad resonance just below the ion plasma frequency. In the zero-frequency limit, the predicted input conductance is essentially the slope of a Langmuir probe current–voltage curve. The prediction of an ion plasma resonance is in qualitative agreement with experiments reported elsewhere. (auth)

14349 TEST CHARGE POTENTIALS IN COLLISIONAL PLASMAS. Yu, M. Y.; Tegeback, R.; Stenflo, L. (Univ., Umeaa, Sweden). Z. Phys.; 264: No. 4, 341-348(1973).

The effect of electron–electron collisions on the potential of slowly moving test particles is considered for homogeneous isotropic plasmas in the absence of external fields. The problem is treated by means of a full BGK model collision operator. The results are valid for arbitrary collision processes. A new dipole-like term is also found. (GE)

14350 AXIAL STRUCTURE IN A THETA-PINCH PLASMA. Dixon, R.H.; Düchs, D.F.; Elton, R.C. (Naval Research Laboratory,

Washington, D. C. 20375). Phys. Fluids 16: No. 10, 1762-1764 (Oct 1973).

Axial irregularities in a θ-pinch plasma are observed during the initial breakdown and main discharge phases. The structure is associated with a gas-breakdown effect. Wavelengths and growth times are consistent with the development of instabilities associated with thermal waves. (auth)

14351 MEASUREMENT OF PLASMA ELECTRON TEMPERATURE WITH AN ION BEAM PROBE. Reinovsky, R.E.; Jennings, W.C.; Hickok, R.L. (Rensselaer Polytechnic Institute, Troy, New York 12181). Phys. Fluids 16: No. 10, 1772-1773 (Oct 1973).

An ion beam probing technique has been developed to measure the electron temperature in a magnetically confined plasma. The technique, involving the use of two alkali metal ion beams, provides accurate measurements of electron temperatures below 100 eV. (auth)

14352 LIGHT SCATTERING FROM COLLISION-DOMINATED PLASMAS. Leonard, E.M.; Osborn, R.K. (Department of Nuclear Engineering, The University of Michigan, Ann Arbor, Michigan 48105). Phys. Rev. A 8: No. 4, 2021-2030 (Oct 1973).

The scattering of electromagnetic radiation by a fully ionized, collision-dominated plasma in a magnetic field is investigated using a stochastic approach. The stochastic equations for the density-fluctuation operators are modified to include particle collisions through a Bhatnagar-Gross-Krook collision model. The equations of this model are constructed to conserve particle number, energy, and momentum. Explicit numerical results are obtained in the absence of magnetic fields and compared to experimental values and other theories. The analytical results are assumed valid for plasmas which can be characterized by Maxwellian velocity distributions for electrons and ions at the same or different temperatures. (auth)

14353 PRESSURE PROFILES OF A PLASMA IN HYDROMAGNETIC EQUILIBRIUM. Hall, L.S. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550); Haste, G.R. Phys. Fluids 16: No. 9, 1536-1537 (Sept 1973).

Measurement of total pressure (or any pressure component) along a magnetic field line determines the full pressure tensor of a plasma in equilibrium. This is applied to an electron-cyclotron-resonance produced plasma, yielding the pressure anisotropy and stability limits of the given experimental device. (auth)

14354 A DYNAMIC MASS SPECTROMETER FOR THE STUDY OF LASER-PRODUCED PLASMAS. Oron, M.; Paiss, Y. (Laboratory for Laser Energetics, College of Engineering and Applied Science, University of Rochester, Rochester, New York, 14627). Rev. Sci. Instrum. 44: No. 9, 1293-1296 (Sept 1973).

A method of multichannel analysis of ions blown off laser-produced plasma is described. The ions are analyzed in a time-of-flight tube followed by a dynamic, capacitorlike, analyzer. This combination enables one to determine simultaneously the relative yield and energy distribution of all the ions created in one laser shot. Design considerations are presented together with some typical experimental results. The spectrometer is currently being used for the diagnostics of laser-produced plasmas. (auth)

14355 POLARIZATION OF FREE-FREE BREMSSTRAHLUNG FROM MAGNETICALLY CONFINED PLASMAS. England, A.C. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). Phys. Rev. A 8: No. 3, 1475-1478 (Sept 1973).

The polarization of bremsstrahlung from electron-ion collisions is calculated for magnetically confined electrons in the Born approximation. The polarization at high temperature is found to be of opposite sign to the low-temperature result and of smaller magnitude. (auth)

Kinetics (General)

Refer also to abstract 13332.

14356 (EP-RR-32) PROCEEDINGS OF THE CANBERRA PLASMA PHYSICS SEMINAR, 9-10 MARCH 1972. Morton, A. H. (ed.). (Australian National Univ., Canberra. Dept. of Engineering Physics). Oct 1972. 241p. (CONF-720355-). Australian National Univ. Press, Canberra $A1.00.

Separate abstracts are given for 13 papers on various aspects of plasmas.

For abstracts of individual papers see: 12984, 13349, 14339, 14340, 14357, 14358, 14377, 14394, 14429, 14430, 14459, 14460, and 15017.

14357 (EP-RR-32, pp 37-54) PLASMA PHYSICS AT WAIKATO UNIVERSITY. Liley, B. S. (Waikato Univ., Hamilton, New Zealand). Oct 1972.

From plasma physics seminar-1972 meeting; Canberra, Australia (9 Mar 1972).

Theoretical and experimental work are described. This includes theoretical work on plasma transport properties with special emphasis on an invariant form for the hydromagnetic stress tensor; the implications of the results of this theory in stability analyses are being considered. On the experimental side, proposed work, using a Θ - Z type plasma gun, on the interaction of a laboratory-simulated "solar wind" with the conducting and nonconducting objects, dipole magnetic fields, and gas clouds is described. Finally, the possible role of trapped particles in heating of ions in a tokamak is considered. (auth)

14358 (EP-RR-32, pp 194-209) TRANSIENT PLASMAS FOR UV LASERS. Haydon, S. C. (Univ. of New England, Armidale, New South Wales). Oct 1972.

From plasma physics seminar-1972 meeting; Canberra, Australia (9 Mar 1972).

Some recent and possible future developments of pulsed gas discharges for producing high-intensity ultraviolet laser radiation from highly transient plasmas are discussed. Deficiencies in the knowledge of such transient plasmas and of the techniques for controlling them are briefly examined, and with reference to recent fundamental studies at the University of New England, the need for a future plasma physics effort in Australia devoted to a fundamental study of the basic ionization and excitation processes in laser plasmas is established. (auth)

14359 CONTRACTION OF CURRENT-CARRYING PLASMA. Pashkin, S.V. (I. V. Kurchatov Institute of Atomic Energy). High Temp. 10: No. 6, 1058-1061 (July 1973).

Special aspects of the contraction of an arc discharge in various gas mixtures are considered. The conditions for the existence of a "normal current density" in the discharge are found. An explanation is given for experimentally-observed sharp changes in current density with changing concentration of alkali additives and molecular impurities. Various methods of obtaining diffuse discharges in gas mixtures are discussed. (auth)

14360 AMBIPOLAR DRIFT, DEFORMATION, AND DIFFUSION OF A PLASMA IN A MAGNETIC FIELD. Monroe, R. L. (Riverside Research Inst., New York). Can. J. Phys.; 51: No. 5, 564-573(1 Mar 1973).

The theoretical problem of a weakly ionized, constant temperature, three-particle plasma in an externally generated magnetic field is reformulated by transforming the set of 14 macroscopic plasma equations (continuity and momentum equations for ions and electrons plus Maxwell's equations) in 14 unknowns (ion and electron number densities and velocities plus the effective electric and magnetic fields) into an equivalent set of 4 integral equations in 4 unknowns. In the course of this transformation, it is shown that the plasma behavior can be interpreted in terms of three ambipolar processes: drift, deformation, and diffusion. Plasma diffusion is characterized by two diffusion coefficients: the usual Schottky formula applying in the direction parallel to the effective magnetic field and a new expression for the ambipolar transverse diffusion coefficient applying in directions perpendicular to the effective magnetic field. The new ambipolar coefficient differs markedly from the familiar ambipolar coefficient associated with the names of Bickerton, Lehnert, Holway, Allis, and Buchsbaum; and, in general, it gives values for the transverse diffusion coefficient which are two orders of magnitude larger than those given by the latter. It is concluded that ambipolar diffusion can produce a transverse diffusion coefficient large enough to account for the diffusion rates measured by Bohm, Burhop, Massey, and Williams in argon arc discharges. (auth)

14361 CALCULATION OF POPULATION DENSITIES OF HELIUM ATOMS IN NON-LTE PLASMAS. Drawin, H. W.; Emard, F.; Katsonis, K. (CEN, Fontenay-aux-Roses, France). Z. Naturforsch.; a28: No. 9, 1422-1431(1973).

Particle densities of helium atoms in the ground and excited states were calculated for non-LTE plasmas on the basis of a collisional-radiative model in which singlet and triplet states were separately taken into account. Distinction is made between two physical situations: 1) a homogeneous stationary state, 2) a transient and/or inhomogeneous plasma state. In both cases, the particle densities were calculated for an optically thin, a slightly optically thick, and strongly absorbing plasmas. Only the results for the homogeneous stationary state are presented. Those for the transient and/or inhomogeneous states have been summarized in numerical tables. The tables are sufficiently complete to permit a wide application in the field of spectroscopic diagnostics of different types of non-LTE plasmas. (GE)

14362 INFLUENCE OF A COAXIAL PARALLEL MAGNETIC FIELD ON A PLASMA JET. Jhoun, C. S. J. Korean Inst. Elec. Eng.; 22: No. 2, 57-69(1973).

The behavior of a plasma jet in a coaxial magnetic field in

parallel with it for controlling the optical characteristics and input power of the plasma jet without impurities and instabilities of the arc column were studied. Because the discharge characteristics of the jet were so distinctively different according to the existence or nonexistence of the magnetic field, the input power, luminous intensity of the plasma jet, and thermal efficiency were comparatively studied in respect to such variables as arc current, electrode gap, quantity of argon flow, magnetic flux density, and diameter and length of nozzle. (Korean Sci. Abstr.)

14363 NUMERICAL STUDY OF THE EFFECTIVE SCATTERING CROSS SECTION OF A LASER BEAM BY A PLASMA IN A MAGNETIC FIELD: APPLICATION TO EXPERIMENTAL DETERMINATION OF DIRECTION OF CONFINING MAGNETIC FIELD. Meyer, R. L.; Leclert, G.; Felden, M. (Univ., Nancy). Can. J. Phys.; 51: No. 3, 266-276(1 Feb 1973). (In French).

The influence of the magnetic field intensity and direction with respect to the wave vector on the scattering cross-section resonances was studied. Good experimental conditions were used for studying these resonances. It is shown that the spectrum modulation of the scattered wave can be used to measure, in some configurations, the confining magnetic field direction. (auth)

14364 GAS DISCHARGES. 2nd International Conference, London, England, September 11–15, 1972. Conference Publication Number 90. Stevenage, Eng.; Institution of Electrical Engineers (1972). 430p. (CONF-720957-). £11.50.

A total of 142 papers are included. The papers are divided according to the following sessions: (1) spark gaps, (2) long sparks and lightning, (3) glow discharges, (4) interruption and recovery, (5) low pressure discharges, (6) lamps and rotation, (7) welding and industrial processes, (8) breakdown theory and processes, (9) discharges in magnetic fields, (10) ac and dc corona, (11) arcs, (12) breakdown, (13) waves in plasmas and rf discharges, (14) breakdown in various gases, (15) arcs in gas flow, (16) breakdown in SF_6 and other electronegative gas, and (17) spectroscopy and plasma diagnostics. (MOW)

14365 PHYSICS AND TECHNOLOGY OF LOW-TEMPERATURE PLASMA. Dresvin, S. V.; Donskoi, A. V.; God'dfarb, V. M.; Klubnikin, V. S. Moscow; Atomizdat (1972). 352p. (In Russian).

Plasmatrons and their technical possibilities are considered together with the composition of a plasma, its thermodynamic functions, and the spectral diagnostics of a low-temperature plasma. Thermal and gasdynamic methods of plasma dynamics are examined, giving attention to the determination of the temperature of heavy particles, the measurement of thermal flows, the measurement of the plasma flow rate, and the determination of plasma flow turbulence. High-frequency induction plasmatrons are discussed together with arc plasmatrons, the theory of the plasma at equilibrium, a two-temperature plasma model, aspects of heat transfer in the case of a flow of a low-temperature plasma about a body, and the dynamics of motion and the heating of refractory particles in plasma jets. (IAA)

14366 OBSERVATION OF BEAM–PLASMA INTERACTION IN A TOROIDAL PLASMA IN A LARGE ELECTRIC FIELD. Strilchuk, A. R.; Skaregard, H. M. (Univ. of Saskatchewan, Saskatoon). Can. J. Phys.; 51: No. 2, 195-202(15 Jan 1973).

Intense bursts of microwave radiation are emitted from a toroidal argon plasma subjected to a large electric field applied parallel to a confining magnetic field. The radiation spectrum was measured in the range 0.95 to 6 GHz. Peaks in the spectrum can be reasonably accounted for by the theory of beam–plasma interaction between a small group of energetic electrons in the discharge and the main plasma. This indicates that the energetic electron group is an identifiable beam rather than part of a long flat tail on the electron velocity distribution. (auth)

14367 RADIAL EXTRACTION OF IONS FROM A PLASMA COLUMN OBTAINED BY REFLEX DISCHARGE. Peureux, J. M.; Braun, J. C. (Univ., Nancy). Phys. Lett.; 46A: No. 2, 93-94 (3 Dec 1973).

A system extracting ions perpendicularly to the magnetic field that confines the plasma is described. This system uses an efficient magnetic screen and a lens focusing the ions onto a quadrupole mass spectrograph. Results are given for H_2 plasma. (auth)

14368 NON-LTE EFFECTS IN AN ARGON CASCADE ARC IN THE PRESSURE RANGE FROM 0.2 ATM TO 5.0 ATM. Garz, D. (Univ., Kiel). Z. Naturforsch.; a28: No. 9, 1459-1467(1973). (In German).

An analysis of the plasma state was performed by determination of the electron temperature and the distribution temperature from end-on intensity measurements in the arc axis and by determination of the heavy-particle temperature from measurements of the electric field strength. The electrical current of the arc was varied between 1.5 and 60 amp and the argon pressure was varied from 0.2 to 5.0 atm. It turned out that not the electron density but the mean free path of the electrons is the essential parameter for the adjustment of LTE. Moreover, radial end-on intensity measurements of Ar-I lines with different upper energy levels revealed significant intensity anomalies spreading from the axis of the arc to the walls. These effects could be explained assuming that a diffusion of Ar atoms, excited to 4s levels, takes place out of the arc axis. The diffusion equation and its solution led to a satisfying explanation of the observed radial non-LTE effects. (GE)

14369 SELF-GENERATED MAGNETIC FIELDS IN LASER PLASMAS. Widner, M.M. (Sandia Laboratories, Albuquerque, New Mexico 87115). Phys. Fluids 16: No. 10, 1778-1780 (Oct 1973).

Numerical simulation and analytic models are used to predict spontaneous magnetic field generation in laser-produced plasmas. Calculations indicate magnetic fields are important for plasmas of controlled fusion interest. (auth)

14370 REPRESENTATION OF DIELECTRIC FUNCTION OF MAGNETIZED PLASMA. Johnston, G.L. (Department of Physics and Astronomy, California State College, Sonoma, Rohnert Park, California 94928). Phys. Fluids 16: No. 9, 1540-1541 (Sept 1973).

A representation of the dielectric function of a uniform magnetized plasma with bi-Maxwellian or model loss-cone distribution functions, which is convenient for computational purposes in the case of large temperature anisotropy or propagation at large angles with the magnetic field, is presented. (auth)

14371 X RADIATION FROM HIGH-ENERGY-DENSITY EXPLODED-WIRE DISCHARGES. Mosher, D.; Stephanakis, S.J.; Vitkovitsky, I.M.; Dozier, C.M.; Levine, L.S.; Nagel, D.J. (Naval Research Laboratory, Washington, D. C. 20375). Appl. Phys. Lett. 23: No. 8, 429-430 (15 Oct 1973).

Exploded-wire discharges of tungsten and titanium driven by a high-power pulse generator have been used to produce intense x-ray continuum and line radiation. A calibrated LiF crystal spectrograph recorded the radiation spectrum in the 3- to 25-keV range. More than 20 J of x radiation are emitted in this photon energy band by tungsten plasmas in less than 50 nsec. The source of emission is less than 1 mm in diameter and about 3.5 cm long. (auth)

14372 EXPERIMENTAL INVESTIGATION OF OSCILLATIONS IN THE DISCHARGE WITH OSCILLATING ELECTRONS. Smirnitskaya, G. V.; Egiazaryan, G. A. (Moscow State Univ.). Izv. Akad. Nauk Arm. SSR, Ser. Fiz.; 8: No. 2, 133-139(1973). (In Russian).

The oscillation frequencies, the discharge steady-state current and the potential drop were measured depending on the discharge parameters. The obtained dependences allow to explain the different states and transition processes in the discharge. (auth)

14373 EFFECT OF RESIDUAL GAS ON IONIZATION WAVES IN INERT GASES. Loudova, K.; David, P. (Charles Univ., Prague). Czech. J. Phys.; 23: No. 10, 1018-1026(1973).

The influence of concentration of residual gases in spectroscopically pure neon on parameters of ionization waves in a low-pressure plasma is considered. The change in the concentration of residual gases was produced by a purification of neon by molecular sieves. The measurements concerned the dispersion and frequency dependences of the amplitude together with the self-excitation limit of p-type ionization waves in neon. (auth)

Kinetics (Experimental)

14374 LASER RADIATION REFLECTION BY A DENSE PLASMA. Rupasov, A. A.; Sklizkov, G. V.; Tsapenko, V. P.; Shikanov, A. S. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz.; 65: No. 5, 1898-1904(Nov 1973). (In Russian).

Results are presented of an experimental investigation of reflection of laser radiation by a plasma. The latter is produced by focusing plane-polarized radiation from a neodymium laser ($\lambda = 1.06\ \mu$) on the surface of targets with various atomic numbers, the radiation flux varying between 5×10^{10} and 5×10^{12} W/cm^2. With fluxes exceeding $\sim 10^{12}$ W/cm^2 an anomalously rapid decrease of the reflection coefficient is observed. A line with a wavelength $\lambda = 0.53\ \mu$ appears in the spectrum of the radiation reflected back into the solid angle of the focusing lens. This line corresponds to the second harmonic of the radiation incident on the target. A ruby laser ($\lambda = 0.69\ \mu$) synchronized with the neodymium laser and with its probing radiation focused onto the same focal spot, is employed for measuring the reflection coefficient at another wavelength. The results obtained are discussed. (auth)

14375 NEGATIVE θ-PINCH EXPERIMENT. Akiyama, R.; Sato, K.; Kawakami, I.; Uchida, T. (Nogaya Univ., Japan). Phys.

Lett.; 45A: No. 5, 411-412(22 Oct 1973).

Plasma temperature obtained with a negative θ-pinch experiment is somewhat lower than that with an ordinary θ-pinch. This is consistent with a numerical calculation assuming Sagdeev resistivity. (auth)

Kinetics (Theoretical)

Refer also to abstract 14479.

14376 (AD-731819) POLARIZATION PROPERTIES OF STARK-SHIFTED LINES EMITTED BY A TURBULENT PLASMA. Kalman, G.; Bakshi, P. (Boston Coll., Chestnut Hill, Mass. (USA). Dept. of Physics). Jun 1971. Contract F19628-71-C-0079. 32p. (AFCRL-71-468). NTIS.

Polarization patterns for Stark-shifted lines under the influence of a distributed electric field are derived for the case of unequal source strengths for pi and sigma polarized emission in order to understand the unexpected experimental results of the AFCRL group. Expressions are obtained for the elements of the density matrix as functions of the direction of observation and the polarizer angle, and guidelines are established for further experimental observations. (auth)

14377 (EP-RR-32, pp 4-21) REVOLUTION IN THE TRANSPORT THEORY FOR TOROIDAL PLASMAS. Ware, A. A. (Univ. of Texas, Austin). Oct 1972.

From plasma physics seminar-1972 meeting; Canberra, Australia (9 Mar 1972).

The discovery of the trapped-particle pinch effect (1970) triggered considerable theoretical interest in the transport properties of toroidal plasmas with low collision frequencies. Four other new physical effects have been discovered and the new transport coefficients show them all to be substantial effects. Several are of major importance to the prospects of toroidal containment for controlled fusion power. (auth)

14378 (UCRL-51439) COMPUTER APPLICATIONS IN CONTROLLED THERMONUCLEAR RESEARCH. Killeen, J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Aug 1973. Contract W-7405-eng-48. 16p. Dep. NTIS $4.00.

This report surveys those areas of plasma physics and controlled thermonuclear research in which computation has made significant contributions. Both fluid and particle models are considered, and applications to specific confinement experiments and plasma theory are discussed. (auth)

14379 MODEL OF "IONIZATION AND RECOMBINATION CHANNELS" IN THE KINETICS OF IONIZATION RELAXATION. Fisun, O.I. (T. G. Shevchenko Kiev State University). High Temp. 10: No. 6, 1062-1067 (July 1973).

An attempt is made to explain the difference between the ways in which two energetically close levels are populated during ionization relaxation. Ionization and recombination are interpreted in terms of an electron diffusing in a discrete energy spectrum and it is assumed that there exist channels through which the excited states are populated. Expressions are obtained for the effective probabilities of single-quantum transitions for each channel and also for the fluxes in each channel as functions of $n_e(t)$ and $T_e(t)$. The population of the levels in each of the channels is also found under the assumption that the flux is quasistationary over a section of the energy space. (auth)

14380 STATISTICAL THEORY OF A NONIDEAL PLASMA. Zelener, B.V.; Norman, G.E.; Filinov, V.S. (Institute of High Temperatures, Academy of Sciences of the USSR). High Temp. 10: No. 6, 1043-1052 (July 1973).

A model of a partially ionized nonideal plasma is proposed. The interaction of ions with continuous-spectrum electrons is described by means of the effective pair potential (pseudopotential). Atoms are treated separately as an ideal gas subject to the condition of ionization equilibrium between the atoms and the subsystem of charged particles. Similarity relations are derived between the thermodynamic variables for various temperatures and various chemical elements. The Monte Carlo method is used to calculate the equations of state and ionization equilibrium over a wide range of values of the nonideality parameter $\gamma = e^2(n_e + n_i)^{1/3}/kT$. The restricted applicability of the Debye-Hückel limiting law is discussed for the weakly nonideal case. The resulting equation of state concurs with the existing experimental data for the domain in which $\gamma \lesssim 1$. (auth)

14381 RADIATION DISTRIBUTIONS IN THE PSEUDOTHERMODYNAMIC MODEL FOR NONTHERMAL PLASMAS. Suckewer, S. (Inst. of Nuclear Research, Warsaw). Lett. Nuovo Cim.; 8: No. 13, 805-810(24 Nov 1973).

The main assumption of the pseudothermodynamic model, adopted also when deriving approximate analytical formulas for populations and ionizations, is the existence of an equilibrium between the excitation and de-excitation processes for a large number of excited levels of atoms (ions) independently of the equilibrium between the ionization and recombination processes. This model concerns a steady-state plasma of unit volume. The assumption was made that the Coulomb interaction between particles is weak and that the particles have Maxwellian velocity distributions with equal temperatures. (MOW)

14382 RADIATION TRANSPORT THEORY BASED ON THE GENERALIZED BIBERMAN-HOLSTEIN FACTOR FOR A NONTHERMAL PLASMA SLAB. Kuszell, A.; Suckewer, S. (Inst. of Nuclear Research, Warsaw). Lett. Nuovo Cim.; 8: No.13, 811-817(24 Nov 1973).

An explicit approximate form for the generalized Biberman-Holstein factor γ_{nm} is derived. The generalized form of the coefficient γ_{nm} for the spectral-radiation distribution r_{nm}^{eff} (source function) was introduced earlier in the frame of a pseudothermodynamic model. The deviation from thermal equilibrium of a bounded plasma is caused by leakage of the radiation energy. This effect perturbs the populations of the excited levels of the atoms, but the velocity distributions of the free particles are assumed to be Maxwellian. In order to maintain the steady state the radiation energy loss is assumed to be compensated by an external source (thermal source, electric current, etc.). The densities N_e of electrons and N_1 of atoms in the ground state are assumed to be space independent. (auth)

14383 APPLICATION OF THE WEDGE TECHNIQUE TO THE MEASUREMENT OF STARK SHIFTS OF PLASMA LINES. Morris, R. N. Vancouver, B. C.; Univ. of British Columbia (1973). National Library of Canada, Ottawa.

Thesis (Ph. D.).

The ability of the GBKO Stark broadening theory to predict the position of the mean of a plasma spectral line is experimentally investigated for three isolated neutral helium lines at electron temperatures of about 1.5 eV and electron densities in the region of $(0.5 \text{ to } 2.0) \times 10^{16}$ cm^{-3}. General agreement was found between experimental and theoretical shifts of the mean of the lines HeI 5016, HeI 4713 and HeI 3889 from their unperturbed wavelengths. A semi-empirical relationship is derived which gives the shift of the mean in terms of the electron impact width, w, and shift, d, as well as in terms of the ion-broadening parameter, α, and the Debye-shielding parameter, r: $\Delta\bar{\lambda} \simeq [d/w \pm 4.1\alpha(1 - 0.5r)]w$. This relationship estimates the shift of the mean within 5% of the width, w, over the ranges $0 \leq \alpha \leq 0.4$ and $0 \leq r \leq 0.8$. The shifts in the means of the observed lines were measured by a new technique employing a linearly varying neutral density filter mounted in the exit plane of a monochromator. This "wedge technique" has a wide range of possible application from steady state to pulsed conditions for observation of Doppler shifts, van der Waals shifts, Stark shifts, or Zeemann shifts. It requires that the line is reasonably isolated, and it is useful when the shift-to-width ratio is either large or small. A complete discussion of the technique is presented along with the important design criteria for linearity, resolution, and sensitivity. (Diss. Abstr. Int., B)

14384 KINETIC THEORY OF A WEAKLY COUPLED AND WEAKLY INHOMOGENEOUS PLASMA IN A MAGNETIC FIELD. Tjøtta, J.N.; Øien, A.H. (Department of Applied Mathematics, University of Bergen, Bergen, Norway). J. Math. Phys. (N.Y.) 14: No. 11, 1629-1636 (Nov 1973).

A study of the evolution toward continuum of a weakly coupled, weakly inhomogeneous two-component electron-ion plasma in an external electromagnetic field using the multiple-time-scale method is presented. An electron-ion mass ratio parameter and a weak inhomogeneity parameter are introduced. Kinetic and macroscopic equations for a certain ordering between these parameters are obtained. The equations are solved when using simplified collision terms. (auth)

14385 RELATIVISTIC ELECTRON BEAM NEUTRALIZATION IN A DENSE MAGNETIZED PLASMA. Chu, K.R.; Rostoker, N. (Laboratory for Plasma Studies and School of Applied and Engineering Physics, Cornell University, Ithaca, New York 14850). Phys. Fluids 16: No. 9, 1472-1479 (Sept 1973).

For the case of a longitudinal magnetic guide field this problem has been treated neglecting ion dynamics [R. Lee and R. N. Sudan, Phys. Fluids 14, 1213 (1971)]. Under the assumptions $\Omega_e > \omega_{pe}, \Omega_i > \omega_{pi}$, where ω_p, Ω are plasma and gyrofrequencies, there is no neutralization because both electrons and ions are tied to field lines. When $\Omega_e > \omega_{pe}$ and $\Omega_i < \omega_{pi}$, it is essential to consider ion dynamics since the ions play the dominant role in neutralization. In the final state, the beam is essentially neutralized both electrically and magnetically and the energy associated with plasma oscillations is a small fraction of the beam energy except when the radius of the beam is small compared with the plasma skin depth. (auth)

14386 APPLICATION OF A CONSISTENT KINETIC EQUATION TO AN INHOMOGENEOUS PLASMA. Heitowit, E.D.; Liboff, R.L. (College of Engineering, Cornell University, Ithaca, New York 14850). Phys. Fluids 16: No. 9, 1446-1455 (Sept 1973).

A consistent kinetic model is developed for investigating wave propagation in a two-component fully ionized, inhomogeneous, low-pressure plasma with collisions. A Gross-Krook-type model is developed with arbitrary parameters determined by the method of Morse [Phys. Fluids 7, 2012 (1964)]. The collision terms of the model satisfy all conservation requirements to a consistent order. A different ordering for the cross-collision frequencies emerges compared to that of some earlier BGK models. The kinetic equations developed are used to obtain a dispersion relation for electrostatic waves in a plasma slab geometry which includes the effects of temperature fluctuations. The gravitational flute mode is investigated, and the present model predicts a larger growth rate for the collisional instability of this mode than earlier BGK models. (auth)

14387 EFFECT OF MAGNETIC SHEAR ON CONVECTIVE PLASMA TRANSPORT. Okuda, H.; Dawson, J.M. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). Phys. Fluids 16: No. 9, 1456-1459 (Sept 1973).

The effect of magnetic shear on convective plasma transport is investigated both by analytic theory and by computer simulations. It is found that the convective diffusion coefficient increases linearly with the shear length until it saturates at the value for close field lines; after this it is constant. It is essentially independent of B for $\omega_{pi} > \omega_{ci}$. (auth)

14388 HOT PLASMA IN CONTACT WITH A COLD WALL. Chu, M.S. (Plasma Laboratory, Columbia University, New York, New York 10027). Phys. Fluids 16: No. 9, 1441-1445 (Sept 1973).

The effect of a cold wall on a hot plasma with initial uniform temperature and strong magnetic field parallel to the wall is studied. For physical values of thermal conductivity, resistivity, and electron-ion equilibration coefficients, the full set of one-fluid, two-temperature equations is solved numerically. These results are then compared with analytic self-similar solutions. The dynamic behavior of the plasma is presented. The total energy loss to the wall per unit area is evaluated and may be approximated rather well by an analytical expression derived from the fundamental equations. (auth)

14389 NONEQUILIBRIUM THERMODYNAMIC RELATION BETWEEN THE DIFFUSION AND CONDUCTIVITY TENSORS IN A MAGNETIZED PLASMA. Corkum, P.B. (Department of Physics, Lehigh University, Bethlehem, Pennsylvania 18015). Phys. Fluids 16: No. 9, 1542-1543 (Sept 1973).

The general relation between the particle diffusion and the electrical conductivity tensors of a plasma in an external magnetic field of arbitrary strength is derived. It is shown that they are not independent quantities from the point of view of nonequilibrium thermodynamics. (auth)

14390 PLASMA TRANSPORT IN A TORUS OF ARBITRARY ASPECT RATIO. Hazeltine, R.D.; Hinton, F.L. (Center for Plasma Physics, The University of Texas, Austin, Texas 78712); Rosenbluth, M.N. Phys. Fluids 16: No. 10, 1645-1653 (Oct 1973).

Finite aspect ratio modifications to neoclassical transport theory are considered. In the general case of arbitrary flux surface geometry, a closed set of macroscopic equations is derived. These include the equation which determines the time evolution of the flux surfaces. In the large aspect ratio case, the $O(r/R)$ corrections to the order $O(r^{(1/2)}R^{(1/2)})$ transport coefficients, calculated previously, are obtained. In particular, an expression for the electrical conductivity is obtained which may be regarded as exact for all experimentally interesting aspect ratios. (auth)

14391 NEW HAMILTONIAN FOR A CLASSICAL PLASMA HAVING ONE COMPONENT. Choquard, P.; Sari, R. R. (Ecole Polytechnique Federale, Lausanne, Switzerland). Helv. Phys. Acta; 46: No. 4, 464-467(1973). (In French).

The traditional expressions for a one-component plasma make implicit use of the hypothesis that the system is translation-invariant. The one-dimensional case is considered in order to illustrate these concepts. A new interaction Hamiltonian is derived which reproduces the Baxter Hamiltonian, but the additive constant is determined precisely. (JSR)

14392 BOUNDARY LAYER WITH AN EXTERNAL MAGNETIC FIELD IN A PLASMA. Ghoshal, S. K. (Regional Engineering Coll., Durgapur, India). Pure Appl. Geophys.; 104: No. 3, 566-573(1973).

Solutions of boundary-layer equations for a plasma in the presence of a magnetic field perpendicular to the direction of the flow were deduced when $P_r = 1$, c_p = constant, and the wall is thermally insulated. The magnetic field H has a dependence on x of the form D/x^m. The velocity in the main stream varies as x^{1-2m}. The solutions were discussed for two particular values of m representing two physical flows. (auth)

14393 ENERGY LOST BY AN ELECTRON BEAM IN INTERACTION WITH A PLASMA. Boyd, D.; Carr, W.; Jones, R.; Seidl, M. (Stevens Inst. of Tech., Hoboken, NJ). Phys. Lett.; 45A: No. 5, 421-422(22 Oct 1973).

Measurements of the electron beam distribution function after the beam has interacted with a plasma, indicate that a large fraction of the energy lost by the beam has been absorbed by the plasma. Only a small fraction is in the wave field. (auth)

Production

Refer also to abstracts 14331, 14354, 14369, and 14455.

14394 (EP-RR-32, pp 83-98) LASER-INDUCED SUPERDENSE PLASMAS. Hughes, J. L. (Australian National Univ., Canberra). Oct 1972.

From plasma physics seminar-1972 meeting; Canberra, Australia (9 Mar 1972).

The rapid developments in the field of laser-induced superdense plasmas are reviewed, and details of experiments that can be undertaken in this new field using powerful Nd^{3+}/glass laser systems are outlined. An optical system is proposed as a solution to the reflection problem encountered with laser-induced superdense plasmas. (auth)

14395 (UCRL-74925) COMPARISON OF X-RAY PHOTOGRAPHS AND CALCULATIONS OF LASER-GENERATED PLASMAS. Shay, H. D.; Seward, F.; Palmieri, T.; Zimmerman, G. B.; Nuckolls, J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1973. 20p. (CONF-731009-6). Dep. NTIS $3.00.

From annual plasma physics meeting of the American Physical Society; Philadelphia, Pennsylvania, USA (31 Oct 1973).

Recent x-ray photographs of plasmas taken at the LLL Plasma x laser (several joules, 50 ps FWHM) facility have achieved spatial resolution of 10 to 20 μm. A detailed comparison is presented of these experimental data with the x-ray images predicted by the two-dimensional Lagrangian hydrodynamics transport code LASNEX. LASNEX's multifrequency photonics has permitted the simulation of x-ray photographs taken of several spectral regions. This series of comparisons elucidates the principal physical processes operative in the plasma plume. (auth)

14396 ELECTRON CASCADE THEORY IN LASER-INDUCED BREAKDOWN OF PREIONIZED GASES. Nielsen, P.E.; Canavan, G.H. (Air Force Weapons Laboratory (DYT), Kirtland Air Force Base, New Mexico 87117). J. Appl. Phys. 44: No. 9, 4224-4225 (Sept 1973).

Calculations are presented which follow the time evolution of the energy distribution function of electrons interacting with an extensively preionized He gas and a CO_2 laser photon field. Explicit account is taken of electron-electron collisions, inelastic and superelastic collisions between electrons and excited species, and inverse bremsstrahlung in the field of ions and neutrals. Computed breakdown thresholds are in agreement with recent data of Brown and Smith. (auth)

14397 IMPROVEMENTS TO HOLLOW-CATHODE PLASMA PRODUCTION DEVICES. Fradin, C. (to Office National d'Etudes et de Recherches Aerospatiales). French Patent 2,161,293. 19 Nov 1971. 9p. (In French).

A plasma producing device is described which possesses at least one hollow cathode, at least one anode, and at least one current generator, the negative terminal of which is connected to the hollow cathode and the positive terminal of which is connected to the anode, this arrangement ensures a continuous discharge between the hollow cathode and the anode. Means are provided for the introduction of a gas into the hollow cathode. In addition, the hollow cathode contains at least one filament, the end of the filament being connected to the hollow cathode through an intermediate resistance. A low-voltage current source is connected across the ends of the filament. (FR)

14398 IMPROVEMENTS TO ION SOURCES. Gautherin, G.; Aubert, J. (to Agence Nationale de Valorisation de la Recherche). French Patent 2,156,978. 13 Oct 1971. 9p. (In French).

An ion source with a duoplasmatron-type primary plasma generator in the form of a hot cathode and an anode (between which the arc is produced) together with an intermediate electrode, maintaining the arc in the region of the small extraction hole provided in the anode, is described. In addition, this ion source possesses a fourth electrode positioned in front of the anode extraction hole. Means are provided for applying a variable potential to this electrode, this potential being positive with respect to the anode. (FR)

14399 PAIR PRODUCTION BY RELATIVISTIC ELECTRONS FROM AN INTENSE LASER FOCUS. Shearer, J.W.; Garrison, J.; Wong, J.; Swain, J.E. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). Phys. Rev. A 8: No. 3, 1582-1588 (Sept 1973).

A preliminary discussion is given of electron–positron pair production by means of electrons accelerated to relativistic velocities at the focus of a laser beam. First, the pair-production cross section was numerically evaluated near its energy threshold. Then, two methods of relativistic electron production by focused laser light were considered: the coherent oscillation of electrons, and the acceleration of a few high-velocity electrons by plasma waves excited by laser-driven instabilities. It was found that the first method would produce pairs for neodymium–laser light at intensities close to the achievable limit (10^{19}–10^{20} W/cm^2). The second method, however, may be capable of producing pairs at lower intensities. (auth)

14400 PICOSECOND FRAMING PHOTOGRAPHY OF A LASER–PRODUCED PLASMA. Richardson, M.C.; Saln, K. (Division of Physics, National Research Council, Ottawa, Canada). Appl. Phys. Lett. 23: No. 8, 420-422 (15 Oct 1973).

Sequential two-dimensional photographs of a laser–produced plasma in air with effective individual exposure times of ≈ 5 psec have been obtained by utilizing a focal-plane optical Kerr effect shutter. (auth)

14401 QUASISTATIONARY SUPERCOOLED (RECOMBINING) PLASMA PRODUCED BY AN ELECTRON BEAM IN A DENSE GAS. Antipov, S. V.; Nezlin, M. V.; Snezhkin, E. N.; Trubnikov, A. S. (Inst. of Atomic Energy, Moscow). Zh. Eksp. Teor. Fiz.; 65: No. 5, 1866-1879(Nov 1973). (In Russian).

Experiments are described in which a quasi-stationary recombining low-temperature helium plasma was produced for the first time, its state differing from the thermodynamically equilibrium one by supercooling of free electrons. The plasma concentration ($N_e \approx 5 \times 10^{15}$ cm^{-3}) for the measured electron temperature (T_e = 0.3 to 0.4 eV) and given concentration of the neutral atom gas $N_0 \approx 2 \times 10^{16}$ cm^{-3}) is greater than the thermodynamically equilibrium concentration (corresponding to the Saha formula) by many orders of magnitude. Correspondingly, the electron temperature is several times smaller than the thermodynamically equilibrium temperature corresponding to the measured plasma concentration. Such a plasma state is obtained in the active zone of the "burning" beam discharge and can be sustained quasistationarily by passing a hard electron beam (electron energy 10 keV, current 10 to 100 A and diameter ~1 cm) through dense He (helium pressure p ≈ 50 to 100 mm Hg). The recombinational nonequilibrium of a quasi-stationary plasma with supercooled electrons thus obtained is opposite in nature to the ionizational nonequilibrium of gas discharges of all "non-beam" forms, in the active zones of which the electrons are (to a greater or lesser degree) always overheated. A method for producing a quasi-stationary supercooled plasma and its spectroscopic diagnostics are discussed. (auth)

Stability

Refer also to abstract 14453.

14402 (KHFTI-73-11) DECAY PROCESSES IN INHOMOGENEOUS PLASMA. Erokhin, N. S.; Mukhin, V. V. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1973. 14p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.00.

Influence of plasma inhomogeneity on decay instability is studied. It is shown that the decay region reduction because of plasma inhomogeneity may lead to decay instability breakdown and also to important changing of the spectrum of the decay oscillations. These effects may be important for plasma processes, both in the laboratory and astrophysical applications. (auth)

14403 EFFECT OF THE TRAPPED-PARTICLE INSTABILITY ON TOROIDAL PLASMA CONFINEMENT. Schmidt, J.A. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey, 08540). Phys. Rev. Lett. 31: No. 5, 289-292 (30 July 1973).

A stability condition is derived for the trapped-electron instability which is valid in both the collisional and collisionless regimes. This instability arises from wave-particle interaction between the perpendicular phase velocity of the waves and the gradient-B drift velocity of the electrons. The stability condition is applied to the FM-1 spherator and ST and PLT tokamaks. (auth)

14404 VELOCITY OF STRIATIONS IN A TRANSVERSE MAGNETIC FIELD. Igitkhanov, Y.L.; Petrov, V.G. (Institute of High Temperatures, Academy of Sciences of the USSR). High Temp. 10: No. 6, 1182-1184 (July 1973).

Solutions were obtained for a linearized system of equations for magnetic striations propagating in a plane transverse to the field. The linear dependence of the frequency and velocity on the field was obtained without the inclusion of magnetorelaxation effects. (MOW)

14405 INSTABILITIES OF A PLASMA WITH ANISOTROPIC ION TEMPERATURE PENETRATED BY THE FIELD OF A HELICON WAVE. Teichmann, J. (Univ. of Montreal). Can. J. Phys.; 51: No. 7, 713-717(1 Apr 1973).

The behavior of instabilities, excited by the anisotropy of the distribution of ion velocities, in the case of a plasma penetrated by a helicon wave, is studied. The modification of dielectric properties of the plasma, induced by the helicon wave, influences substantially the onset of instabilities and reduces their growth rates. Thus a dynamic stabilization for some dangerous microinstabilities, which are based on collective interaction between both plasma species, could be achieved. (auth)

14406 TWO-STREAM ELECTROMAGNETIC INSTABILITY. Seshadri, S. R. (Univ. of Wisconsin, Madison). Can. J. Phys.; 51: No. 3, 277-286(1 Feb 1973).

The characteristics of the instability of an electromagnetic wave propagating obliquely to a double stream in a plasma are investigated. Instability is shown to exist for all directions of the stream. The direction normal to the wave vector is a singular case for which the unstable wave has a zero frequency of oscillation and a growth rate which increases from zero as the wavenumber is increased and asymptotically approaches a maximum value for very large wavenumbers. For all other directions unstable waves exist for wavenumbers below a critical value. The frequency of oscillation increases monotonically from zero as the wavenumber is increased and reaches a maximum value at the cutoff wavenumber but the growth rate increases from zero as the wavenumber is increased, reaches a maximum value, and then decreases to zero at the critical wavenumber. The dependence of the frequency of oscillation and the growth rate of the unstable wave on the direction of the stream with respect to the wave vector is also examined. Many of the features of this instability, particularly for other than the singular direction, are predicted correctly by the quasi-static approximation. (auth)

14407 AN ELECTRON ATTACHMENT PLASMA INSTABILITY. Douglas-Hamilton, D.H.; Mani, S.A. (Avco Everett Research Laboratory, Inc. Everett, Massachusetts 02149). Appl. Phys. Lett. 23: No. 9, 508-510 (1 Nov 1973).

A new type of plasma instability is described in an electron–beam ionized discharge. This instability occurs in gas mixtures in which the dissociative attachment rate increases strongly with electric field. It has been observed experimentally in He:H_2O 740 : 20 and in He:CO_2 1:1 and 9:1 mixtures. The values of the ionization source function S and of the electric field E at which the wave instability occurs are predicted using a Fourier analysis of the linearized kinetic rate equations. This yields the condition for instability as $S < (1/\alpha)[E(\alpha\beta/\alpha E) - \beta]^2$, where α is the electron–ion recombination coefficient and β is the electron neutral attachment rate. (auth)

14408 MULTIPOLE-LIKE SOLUTIONS FOR AN EQUILIBRIUM PLASMA CARRYING NONUNIFORM CURRENT. Bhadra, D.K. (Gulf General Atomic Company, San Diego, California 92138). Phys. Fluids 16: No. 10, 1781-1782 (Oct 1973).

It is shown that multipole-like solutions exist for an equilibrium plasma carrying nonuniform current. A special case is obtained where flux constant surfaces resemble the figure eight. (auth)

14409 MAGNETICALLY INDUCED INSTABILITY IN SHOCK-HEATED ARGON. Hardy, R.H.S. (Faculty of Engineering, University of Saskatchewan, Regina Campus, Regina, Canada). Phys. Fluids 16: No. 9, 1429-1434 (Sept 1973).

Observations of a highly structured discharge and current instability in unseeded shock heated argon flowing through a region of large transverse magnetic field are presented and analyzed. The experimental results are related to an extension of the theory of electrothermal (ionization) instability in partially ionized gases in which the presence of multiply charged ions is taken into account. (auth)

14410 SCALING LAWS AND UNIVERSAL SPECTRUM OF STRONG PLASMA TURBULENCE. Ichimaru, S. (Department of Physics, University of Illinois, Urbana, Illinois 61801). Phys. Rev. A 8: No. 4, 2085-2089 (Oct 1973).

Scaling laws of strong plasma turbulence are obtained with the aid of similarity transformation of physical parameters in the Bogoliubov–Born–Green–Kirkwood–Yvon hierarchy equations. Possible existence of a universal spectrum proportional to k^{-3} is discussed. The scaling arguments are extended to the analysis of the rate of turbulent heating and the anomalous resistivity. It is also shown that the scaling laws are useful in resolving an apparent paradox in the interpretation of the Crab pulsar spectrum. (auth)

14411 PARALLEL VELOCITY SHEAR INSTABILITIES IN AN INHOMOGENEOUS PLASMA WITH A SHEARED MAGNETIC FIELD. Catto, P.J.; Rosenbluth, M.N.; Liu, C.S. (Institute for Advanced Study, Princeton, New Jersey 08540). Phys. Fluids 16: No. 10, 1719-1729 (Oct 1973).

Injection of fast neutrals with a component of the beam velocity along the magnetic field B_0 results in a plasma having a sheared mean velocity along B_0. If this parallel velocity shear U' and the density inhomogeneity scale length L_n are large enough so that $U'|L_\parallel|/(\tau + 1)^{1/2}v_i > 1$ then a parallel Kelvin–Helmholtz instability is excited, where v_i is the ion thermal speed and τ is the electron temperature/ion temperature. Magnetic shear stabilization requires a shear length L_s comparable to or less than $|L_\parallel|$, namely, $\tau L_n/3(\tau + 1) < v_i/U' < |L_\parallel|/(\tau + 1)^{1/2}$. For $U'|L_\parallel|/(\tau + 1)^{1/2}v_i < 1$, however, this parallel Kelvin–Helmholtz instability is stabilized and only drift wave instabilities can be excited. For $\tau \approx 1$ and $(M/m)^{1/2} \approx 43$, the first of these drift wave instabilities is unstable for $U'/\Omega_i > 172|(L_n/L_s)^{3/2}|$ provided $|L_n/L_\parallel| < a_i/30|L_\parallel|$ while the second is stable for $U'/\Omega_i < 136a_i/|L_\parallel|$ provided $|L_n/L_\parallel| > 600$ and $U'/\Omega_i \ll 1$, where a_i and Ω_i are the ion gyration radius and frequency. (auth)

14412 NONLINEAR DEVELOPMENT OF THE TWO ION BEAM INSTABILITY. Baker, D.R. (European Space Research Institute, I–00044 Frascati, Rome, Italy). Phys. Fluids 16: No. 10, 1730-1739 (Oct 1973).

The nonlinear development of the two ion beam instability has been experimentally investigated. The ion acoustic turbulence grows and stabilizes in conjunction with a significant change in the average ion distribution function. A quasilinear type theory is developed for ion waves in a boundary value problem which appears to predict most of the observed nonlinear behavior of the instability including excited waves and the growth of the background noise. A brief discussion of trapping and strong turbulence effects is given. (auth)

14413 ROLE OF TURBULENCE IN THE COUPLING OF A MAGNETIC PULSE TO A COLLISIONLESS PLASMA. Davis, W.D.; DeSilva, A.W. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). Phys. Fluids 16: No. 10, 1740-1748 (Oct 1973).

The coupling of a magnetic pulse to an initially magnetized collisionless plasma is studied experimentally using a high voltage theta pinch. The plasma parameters studied include: the turbulent electric fields, particle heating, magnetic and electric field profiles, and the plasma resistivity. The results indicate that the interaction of the plasma with the magnetic pulse can be understood using a fluid model which includes anomalous resistivity and particle heating. The source of the anomalous resistivity is investigated based on the presently available instability theories. (auth)

14414 TURBULENT DIFFUSION COEFFICIENTS OF TOROIDAL PLASMAS. Yoshikawa, S. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). Phys. Fluids 16: No. 10, 1749-1752 (Oct 1973).

The diffusion coefficient of a plasma with density gradient–produced fluctuations was calculated. Two different methods of deriving the diffusion coefficients were used. Then, the condition that two methods yield the same result is used to determine the phase angle α between the density and the potential fluctuations. The result shows the pseudo–classical diffusion coefficients. Agreement with experimentally determined plasma confinement times is satisfactory. (auth)

14415 PARAMETRIC INSTABILITY OF A RELATIVISTICALLY STRONG ELECTROMAGNETIC WAVE. Max, C.E. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). Phys. Fluids 16: No. 9, 1480-1489 (Sept 1973).

The stability of a circularly polarized electromagnetic wave that is strong enough to make plasma electrons, but not ions, relativistic is studied. Small perturbations are considered which propagate parallel to the large-amplitude driver. A relativistically strong wave can be unstable on time scales as short as twice its own oscillation period, and decays into a forward–going plasma oscillation and either one or two electromagnetic waves. Ion motion introduces an additional instability which can be important at short perturbation wavelengths, where the driver would otherwise be stable. The unstable ion and electron modes both have potential for producing anomalously large acceleration of relativistic particles, as well as significant amounts of backscattered light. These effects may be important in two applications: (1) the use of intense lasers to heat or compress plasma, and (2) the plasma surrounding a pulsar, if the pulsar is losing energy by radiation of electromagnetic waves at its rotation frequency. Instability persists in the nonrelativistic regime, reducing to stimulated Raman scattering as a special case. (auth)

14416 STRUCTURE IN THE NONLINEAR SATURATION SPECTRUM OF PARAMETRIC INSTABILITIES. Fejer, J.A. (Max–Planck–Institut für Physik und Astrophysik, Institut für Extraterrestriache Physik, Garching, Germany); Kuo, Y. Phys. Fluids 16: No. 9, 1490-1496 (Sept 1973).

The nonlinear saturation spectrum of the decay instability is obtained in the limit of small spontaneous emission, for comparable ion and electron temperatures, from numerical solutions of a kinetic equation based on an accurate expression for the nonlinearity. The spectral energy occupies several pairs of isolated saucer–shaped regions in wave–vector space. The regions increase in thickness, angular diameter, and number as the pump power is increased. The theory thus predicts the generation of waves propagating in directions which can differ substantially from the direction of the pump field. Ionospheric observations confirm this prediction; they were difficult to reconcile with the predictions of previous theories based on an approximate expression for the nonlinearity. The present work also corrects the results of previous one–dimensional theories that used an accurate expression for the nonlinearity and predicted "spectral lines" in the limit of vanishing spontaneous emission. Excitation of the purely growing instability is predicted for pump powers greater than about 2.5 times the threshold of the decay instability. (auth)

14417 MODEL OF KINK MODES AND THEIR FEEDBACK STABILIZATION. Lowder, R.S.; Thomassen, K.I. (Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Fluids 16: No. 9, 1497-1500 (Sept 1973).

The kink modes of a cylindrical plasma carrying a uniform current are described in terms of the perturbed currents and fields arising from a helical displacement of the plasma. This description gives the well–known dispersion and stability relations, and illustrates the stabilizing role of feedback magnetic fields. (auth)

14418 PLASMA INSTABILITY AT AN X–TYPE MAGNETIC NEUTRAL POINT. Baum, P.J.; Bratenahl, A.; Kao, M.; White, R.S. (Institute of Geophysics and Planetary Physics, University of California, Riverside, California 92502). Phys. Fluids 16: No. 9, 1501-1504 (Sept 1973).

Time–resolved measurements of temperatures, density, and other parameters which describe the plasma at the X–type neutral point of the double inverse pinch laboratory discharge device are reported. Turbulent resistivity develops in this experiment without the usual application of an external electric field. The electric field is generated by field line reconnection or magnetic flux transfer. Various conductivity mechanisms are examined including binary collisions, space charge current limitation (Alfven–Carlqvist instability), and other current driven instabilities. The evidence suggests that the ion–acoustic instability is responsible for the observed current cutoff and turbulent conductivity. However, this instability must be driven well above its normal threshold. The competing effects of electron runaway and wave–particle interactions are discussed. (auth)

14419 CONVERGENCE OF STRONG TURBULENCE THEORY. Thomson, J.J. (Lawrence Livermore Laboratory, Livermore, California 94550); Benford, G. Phys. Fluids 16: No. 9, 1505-1507 (Sept 1973).

The orbital diffusion view of plasma turbulence differs from the usual treatment of particle motion, in that the "free" particle propagator is changed to a renormalized propagator. This new propagator contains information about the perturbing effects of the self–consistent field. It is shown that the perturbation series formed with this new propagator converges rigorously. Physical effects included in the perturbation series are discussed. (auth)

14420 NONLINEAR THEORY AND ANGULAR SPECTRUM OF THE ION–ACOUSTIC INSTABILITY. Sleeper, A.M.; Weinstock, J.; Bezzerides, B. (Aeronomy Laboratory, National Oceanic and Atmospheric Administration, Boulder, Colorado 80302). Phys. Fluids 16: No. 9, 1508-1518 (Sept 1973).

A nonlinear theory of the current–driven ion–acoustic instability is presented. The saturation mechanism is the perturbation of the ion orbits by the turbulent waves, which results in a broadening of the resonant interaction between the ions and the waves. The angular spectrum and rms field fluctuation energy are calculated and compared both with experiment and two–dimensional computer simulations. An approximate expression for the angular spectrum, obtained in three dimensions, predicts a broad angular spectrum as well as a fluctuation level which is in order of magnitude agreement with two recent experiments. More complete numerical results in two dimensions also predict a broad angular spectrum in agreement with the two–dimensional simulations, and a fluctuation level in very good numerical agreement with the simulations. (auth)

14421 TURBULENTLY HEATED DISTRIBUTION FUNCTIONS AND PERTURBED ORBIT THEORY. Katz, J.I.; Weinstock, J.; Kruer, W.L.; DeGroot, J.S.; Faehl, R.J. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). Phys. Fluids 16: No. 9, 1519-1521 (Sept 1973).

The perturbed orbit plasma–turbulence theory of Dupree and Weinstock predicts the evolution of the electron–distribution function according to a diffusion equation. The electric field spectrum in one–dimensional electrostatic simulations of the modified two–stream instability is used to obtain the theoretical diffusion coefficient. The diffused distribution function is compared with the actual distribution function in the simulation as a test of the theory. (auth)

14422 EXPERIMENTAL DETERMINATION OF THE NONLINEAR INTERACTION IN A ONE DIMENSIONAL BEAM–PLASMA SYSTEM. Gentle, K.W.; Lohr, J. (University of

Texas at Austin, Austin, Texas 78712). Phys. Fluids 16: No. 9, 1464-1471 (Sept 1973).

Recent theories have shown that the instability driven by a cold, weak electron beam in a one-dimensional plasma is stabilized when the unstable wave grows to an amplitude sufficient to trap the electron beam. Quantitative measurements of the instability confirm every prediction of the theory: the maximum wave amplitude, monochromaticity of the unstable mode, harmonic content of the mode, and wavelength of the slow oscillation in wave amplitude. The electron beam goes through the same patterns in phase space and time-averaged f(v) as predicted. Both scaling and absolute magnitudes agree with theory. (auth)

14423 NONLINEAR SATURATION OF THE RELATIVISTIC BEAM-PLASMA INSTABILITY IN THE PRESENCE OF ION DENSITY FLUCTUATIONS. Toepfer, A.J.; Poukey, J.W. (Sandia Laboratories, Albuquerque, New Mexico 87115). Phys. Fluids 16: No. 9, 1546-1547 (Sept 1973).

The effect of finite ion density fluctuations driven by return current instabilities on the nonlinear saturation level of the relativistic beam–plasma instability is calculated for cases of experimental interest. The effect of initial plasma temperature is also discussed. (auth)

14424 COMMENTS ON "ELECTROMAGNETIC WAVE INSTABILITY IN A COLD ELECTRON-ION PLASMA". Ignat, D.W. (Centre de Recherches en Physique des Plasmas, 1007 Lausanne-Switzerland); Hirshfield, J.L. Phys. Fluids 16: No. 9, 1556-1556 (Sept 1973).

In a recent note Seshadri used cold plasma theory to examine the instability of an electromagnetic wave propagating at an angle to the direction of streaming electrons through stationary hydrogen ions. One conclusion from this study was that, for a large range of angles, the growth rates of the radiative instability that exists for oblique angles could be obtained from the previously published growth rates of the purely longitudinal instability that occurs at $\theta = 0$. An analytical confirmation of this is presented using a relativistic dispersion relation. (MOW)

14425 STABILIZATION OF CONICAL TYPE INSTABILITY IN A MIRROR TRAP. Kanaev, B. I.; Pastukhov, V. P.; Yushmanov, E. E. (Inst. of Atomic Energy, Moscow). JETP Lett. (USSR) (Engl. Transl.); 18: No. 6, 204-206(20 Sep 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 6, 347-350(20 Sep 1973).

Experiments were conducted in the PR-6 apparatus in order to study the stabilization effect of microwaves near ω_{Be}. Diagrams are given showing the instability development during free decay and also during the microwave pulse. The potential of the floating probe in the central section of the PR-6 device is shown before and during the microwave pulse. (MOV)

14426 INSTABILITIES DUE TO NEGATIVE-PRESSURE EFFECTS. Yu, M. Y.; Shukla, P. K. (Ruhr Univ., Bochum, Ger.). Phys. Lett.; 45A: No. 5, 415-416(22 Oct 1973).

The presence of a negative-pressure component in a plasma causes low-frequency electrostatic ion waves to become unstable if the number density of that component is sufficiently high or its temperature sufficiently low. (auth)

Thermonuclear Engineering and Equipment

Refer also to abstracts 13167, 13797, and 14332.

14427 (ANL-7996, pp 156-164) CHEMISTRY IN THE DEVELOPMENT OF CONTROLLED FUSION. Feb 1973.

Chemistry division annual report, July 1971–June 1972.

Summaries are given for work during this period on the following areas; (1) chemical effects of plasma interactions with thermonuclear reactor surfaces, (2) correlation between gaseous atomic spectra and the absorption spectra of atoms isolated in noble-gas matrices, (3) absorption spectra of niobium atoms isolated in noble-gas matrices, (4) infrared absorption spectra of isotropic NbN and NbO molecules in an argon matrix, (5) systematics of diatomic metal deuteride and tritide molecules, and (6) neutron scattering studies of hydrogen in metals. (MOW)

14428 (CONF-731114-41) ENGINEERING AND MANAGEMENT ASPECTS OF THE ORMAK PROGRAM. Roberts, M. (Oak Ridge National Lab., Tenn. (USA)). 1973. 11p. Dep. NTIS $3.00.

From 5th symposium on engineering problems of fusion research; Princeton, New Jersey, USA (6 Nov 1973).

A review of the ORMAK program is given. The review briefly covers the engineering development of the ORMAK program in terms of injection research, high-field ORMAK, ORMAK F/Bx, magnet development, and liner surface development. Management requirements of the ORMAK program are also discussed. (MOW)

14429 (EP-RR-32, pp 63-82) LT-4 PROPOSAL. Morton, A. H. (Australian National Univ., Canberra). Oct 1972.

From plasma physics seminar-1972 meeting; Canberra, Australia (9 Mar 1972).

After describing briefly the typical tokamak and some aspects of the behavior of plasma in such a device, the three versions of the Liley Torus that have been operated to date are discussed. Reasons for considering a further version, LT-4, are put forward in terms of the need for a device free of the inherent shortcomings of LT-3 and in terms of requiring a system with a greater range in operating parameters. Dimensions and magnitudes tentatively adopted for LT-4 are presented, and some comment is made on diagnostics. (auth)

14430 (EP-RR-32, pp 99-115) TEXAS TURBULENT TORUS EXPERIMENT. Robson, A. E. (Univ. of Texas, Austin). Oct 1972.

From plasma physics seminar-1972 meeting; Canberra, Australia (9 Mar 1972).

Plasma heating through turbulent resistivity was demonstrated in a number of small experiments, but so far it has not been applied to the heating of plasma in a containment experiment. It is envisaged that the Texas tokamak will obtain electron temperatures of the order 10 keV through turbulent heating. Diagnostic methods to be used and the anticipated plasma conditions are described, and the effects caused by turbulent heating are considered. (AT)

14431 (LA-UR-73-1593) PARAMETER STUDY OF θ-PINCH PLASMA PHYSICS REACTOR EXPERIMENT. Rogers, J. D.; Baker, B. L.; Weldon, D. M. (Los Alamos Scientific Lab., N.Mex. (USA)). 1973. 25p. (CONF-731114-42). Dep. NTIS $3.25.

From 5th symposium on engineering problems of fusion research; Princeton, New Jersey, USA (6 Nov 1973).

A parameter study of a superconducting magnetic energy transfer and storage (METS) driven θ-pinch plasma physics reactor experiment was made, comparing direct and transformer coupled systems from the primary energy storage coil. Superconducting switches were considered and both capacitive and noncapacitive transfer schemes were analyzed. Approximately twenty major cost items were included as a function of transfer time, plasma compression coil field, compression coil radius, primary storage coil field and current, peak voltage across the terminals of the storage coil, transformer turns ratio, spacing between the primary and secondary of the transformer coupled system, and ratio of resistances of a parallel resistor to the normal state superconducting switch. The study indicates the minimum cost system and provides direction for engineering design. A separated-shock, θ-pinch plasma experiment with shock heating by high-voltage circuits whose energy content is only a few percent of that of the total magnetic field energy was examined. The compression field energy, which constitutes the bulk of the energy, is contained in a multiturn coil driven by a superconducting inductive energy source with millisecond transfer times appropriate to adiabatic compression of a θ-pinch plasma in long systems to obtain $kT \approx 10$ keV and $n\tau \approx 10^{14}$ cm^{-3} sec. The study optimizes the physical circuit values and costs of the entire system except the shock heating circuit, which is included, however, and is a nontrivial cost item. Switching of the stored compression energy is accomplished by a normal-going, superconducting switch. (auth)

14432 (LA-UR-73-1603) ENGINEERING DESIGN CONSIDERATIONS FOR LASER CONTROLLED THERMONUCLEAR REACTORS. Williams, J. M.; Finch, F. T.; Frank, T. G.; Gilbert, J. S. (Los Alamos Scientific Lab., N.Mex. (USA)). 1973. Contract W-7405-eng-36. 17p. (CONF-731114-44). Dep. NTIS $3.00.

From 5th symposium on engineering problems of fusion research; Princeton, New Jersey, USA (6 Nov 1973).

The following topics are discussed: (1) characterization of DT pellet microexplosions, (2) reactor cavity and blanket design, (3) laser systems, (4) laser-beam transport subsystem, (5) fuel cycles. (MOW)

14433 (LA-UR-73-1604) MOVING ENERGY STORAGE CAPACITOR RACKS WITH AIR BEARINGS. Banta, J. J.; Hammer, C. F. (Los Alamos Scientific Lab., N.Mex (USA)). 1973. Contract W-7405-eng-36. 14p. (CONF-731114-24). Dep. NTIS $3.00.

From 5th symposium on engineering problems of fusion research; Princeton, New Jersey, USA (6 Nov 1973).

Although Scyllac was proposed in 1966 as a 15-m-circumference toroidal apparatus, it was initially installed as a dual device; a 120° 5-m-long toroidal-sector experiment and a 10-m-long linear experiment with mirrors on each end. After preliminary experi-

ments were completed, conversion of the equipment to a full-torus configuration was started early in 1973. One of the major conversion tasks was the moving of 30-ft-long × 7-ft-wide × 37-ft-high, 65-ton racks loaded with energy-storage capacitors into a toroidal configuration. The original conversion scheme involved the disassembly and unwiring of each rack and reassembling it in its new position. This would have been expensive and time-consuming. This plan was abandoned when a careful study showed that an entire rack structure could be moved as one assembly on air bearings. The air bearings used were round, flat devices that were commercially developed to move considerable loads while supporting them on a cushion of constantly escaping low-pressure air. After the machine and capacitor racks were firmly clamped together with large structural beams, 42 air bearings were installed underneath. The air bearings were supplied with air at about 18 psi to raise the entire structure about $\frac{1}{8}$ in. The racks were moved to their new locations with "come-along" jacks and muscle power. The use of air bearings saved nearly one-half million dollars in electrician and rigger time. (auth)

14434 (LA-UR-73-1610) EXPLODING FOIL DEVELOPMENT FOR INDUCTIVE ENERGY CIRCUIT. Haarman, R. A.; Dike, R. S.; Hollen, M. J. (Los Alamos Scientific Lab., N.Mex. (USA)). 1973. Contract W-7405-eng-36. 7p. (CONF-731114-36). Dep. NTIS $3.00.

From 5th symposium on engineering problems of fusion research; Princeton, New Jersey, USA (6 Nov 1973).

Copper foil fuses are used in the LASL Z-pinch CTR program to provide a method of transferring inductively stored energy, in an inductive storage system, from the storage inductor into the load with an $\dot{I} \approx 1.5 \times 10^{12}$ amps/sec. Contemporary fuses at LASL consisting of a copper foil folded around a small sheet of polyethylene and surrounded by an open box containing glass beads (sand) have experienced serious operating difficulties including debris being ejected between collector plates, deterioration of contact electrodes upon firing, and difficulty of fuse replacement. A development program was initiated to design a fuse that could be used on the existing experiment and also on the proposed increased energy level ZT-S experiment at LASL. The ultimate goal was to obtain a single fuse package or pair of fuses (including an inverted fuse) capable of absorbing a total of 40 kJ energy. A fuse test header was built capable of testing fuse concepts to include inverted fuses, various arc quenching materials, and modes of energy absorbing methods. The energy system for the test header was a 60-kJ, 20-kV ignitron switched capacitor bank. The final fuse design is a 35 cm × 35 cm disposable package that consists of a hairpin shaped 1-mil-thick copper foil separated by a single 60-mil sheet of ABS plastic and sandwiched between two 1.2 cm layers of sand. The fuse package is capable of absorbing 20 kJ of energy without rupture, can be fired in an inverted position, and produces no contact burning or electrode degradation on the experiment. (auth)

14435 (LA-UR-73-1611) DEVELOPMENT OF A HIGH-EXPLOSIVE DRIVEN CROWBAR SWITCH. Dike, R. S.; Kewish, R. W. Jr. (Los Alamos Scientific Lab., N.Mex. (USA)). 1973. Contract W-7405-eng-36. 16p. (CONF-731114-32). Dep. NTIS $3.00.

From 5th symposium on engineering problems of fusion research; Princeton, New Jersey, USA (6 Nov 1973).

A compact explosively-driven, metal-to-metal contact, solid dielectric switch was developed for use as a low-resistance, <10-μΩ, low-inductance, <10-nH, crowbar switch. A 100-milligram high-explosive charge is used to extrude a 0.090-in. plate through 0.040-in. polyethylene and achieve a hard current contact with a 0.625-in.-diameter die plate. The closure time, from the signal, which initiates the charge, to beginning of current rise in the switch, is 11.0 μsec ± 0.3 μsec. In crowbar application the switch has carried 180 to 330 kA, which decays with a 1/e time of ≈ 1.2 msec. (auth)

14436 (LA-UR-73-1625) LASER CONTROLLED THERMONUCLEAR REACTOR MATERIALS REQUIREMENTS. Williams, J. M.; Frank, T. (Los Alamos Scientific Lab., N. Mex. (USA)). 1973. Contract W-7405-eng-36. 26p. (CONF-731101-46). Dep. NTIS $3.50.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973).

A general discussion is presented on the following topics: (1) characterization of laser-CTR materials environment, (2) cavity concepts, (3) blanket concepts, (4) laser systems, laser-beam transport subsystem, (5) fuel cycle, (6) materials considerations, and (7) pellet fabrication and injection. (MOW)

14437 (LA-UR-73-1629) ELECTRON-BEAM-CONTROLLED LASERS: DISCUSSION FROM THE ENGINEERING VIEWPOINT. Part I. Design of the 1 kJ and 10 kJ CO_2 Lasers. Stapleton, R. E.; Riepe, K. B.; Jolly, E. L. Jr.; Weinbrecht, J.; Hayden, J. J.; Ferdinand, E. O.; Carroll, T. A. (Los Alamos Scientific Lab., N. Mex. (USA)). 1973. Contract W-7405-eng-36. 23p. (CONF-731114-43). Dep. NTIS $3.25.

From 5th symposium on engineering problems of fusion research; Princeton, New Jersey, USA (6 Nov 1973).

The Los Alamos Scientific Laboratory (LASL) CO_2 laser program was organized to design, fabricate, and evaluate high-energy, short-pulse CO_2 lasers for use in fusion studies. A general discussion of electron-beam-controlled lasers is included, along with details of component designs. This includes a discussion of the high-voltage pulsers, electron guns, pumping chamber vessels, timing, and operational experience with the 1-kJ CO_2 laser system components. In addition, the general design of the 10-kJ CO_2 laser system is presented. (auth)

14438 (LA-UR-73-1653) EVALUATION OF MAJOR MATERIAL PROBLEMS ANTICIPATED FOR THE REFERENCE THETA-PINCH REACTOR (RTPR). Bunch, J. M.; Clinard, F. W.; Dudziak, D. J.; Green, W. V.; Krakowski, R. A. (Los Alamos Scientific Lab., N. Mex. (USA)). 1973. Contract W-7405-eng-36. 15p. (CONF-731114-28). Dep. NTIS $3.00.

From 5th symposium on engineering problems of fusion research; Princeton, New Jersey, USA (6 Nov 1973).

The thermal and neutronic environment which is a consequence of the present RTPR design is briefly summarized. On the basis of this summary, specific materials problems, anticipated solutions to these problems, and areas of uncertainty are enumerated and discussed. Whenever the present data base permits, quantitative assessment of problem areas are given. Areas of materials research which must be developed and/or extended are identified. (MOW)

14439 (LA-UR-73-1752) DESIGN OF A HIGH-VOLTAGE GENERATOR FOR THE LASL IMPLOSION-HEATING EXPERIMENT. Hammel, J. E.; Henins, I.; Marshall, J.; Sherwood, A. R. (Los Alamos Scientific Lab., N. Mex. (USA)). 1973. Contract W-7405-eng-36. 4p. (CONF-731114-37). Dep. NTIS $3.00.

From 5th symposium on engineering problems of fusion research; Princeton, New Jersey, USA (6 Nov 1973).

The goals of the LASL implosion-heating experiment are to learn more about the physical processes involved in the initial implosion of a theta pinch and to find ways of enhancing the amount of implosion heating. The design parameters chosen for the experiment are: an initial plasma density of 10^{15} deuterons per cm^3, a 40-cm-diameter discharge tube, a coil length of one meter, an initial electric field of 2 kV/cm applied to the inside of the discharge tube, and a magnetic field of 10 kG having a fast risetime and lasting for 500 nsec. This experiment differs from the collisionless shock experiments that have been conducted over the past few years at other laboratories in that a much higher initial plasma density is present. The higher density reduces the effective impedance of the plasma and thus requires a lower-impedance current source. The design of a high-voltage pulse generator is described. Systems that have been considered are: 1) Mylar-insulated stripline Blumlein generators, 2) simple Mylar striplines, 3) combinations of Mylar striplines with capacitors, 4) water-insulated coaxial transmission lines, 5) capacitors, and 6) lumped-constant transmission lines. The system finally selected is a hybrid of a peaking-capacitor system with a curtailed, lumped-constant delay line. All systems were investigated by computation, mostly using the NET-2 code. The calculation takes into account the changing impedance of the load due to the motion of the imploding plasma sheath. Plasma dynamics were simulated using the bounce model, which assumes perfect elastic reflection of all ions from an impinging magnetic piston. The final design employs four coil feed points with a 125-kV generator at each one, totaling 500 kV. Each 125-kV generator consists of a pulse-charged two-element lumped-constant line. An essential feature of the circuit is fast charging from Marx generators through the inductance of the Marx and of the connecting cable system. The load switches are fired when the voltage on the lumped-constant line reaches 125 kV, at which time the voltage is still rising rapidly. At the peak load current, about 300 kA is contributed by the charging current from the Marx bank and 500 kA comes from the capacitors of the lumped-constant line. (auth)

14440 (LA-UR-73-1753) HIGH-VOLTAGE TECHNOLOGY FOR THE LASL IMPLOSION-HEATING EXPERIMENT. Hammel, J. E.; Henins, I.; Marshall, J.; Sherwood, A. R. (Los Alamos Scientific Lab., N. Mex. (USA)). 1973. Contract W-7405-eng-36. 4p. (CONF-731114-38). Dep. NTIS $3.00.

From 5th symposium on engineering problems of fusion research; Princeton, New Jersey, USA (6 Nov 1973).

The implosion-heating power supply uses four 125-kV generators in series. Each generator consists of a fast 125-kV pulse-forming network made up of capacitors attached to a 1-m-wide parallel-plate transmission line which is fed through multiple cables from a 2.5-μF, 0.5-μH Marx bank charged to 180 kV. To simplify construction it was decided to do without oil or water for high-voltage insulation and grading. The developments described here are: (1) a low-inductance connection between the 125-kV capacitors and the parallel-plate transmission line using an elastomer gasket capable of holding 200 kV; (2) edge flashover prevention by "ballooning" the sheet insulation, by which a 10-cm edge extension of insulation is capable of withstanding a 200-kV pulse for several microseconds; (3) using the edge flashover for over-voltage prevention; (4) grading of voltage along insulators with conducting plastic sheets to prevent flashover at the load switches and cable connections; and (5) capacitively graded insulating supports for the Marx banks. (auth)

14441 (LA-UR-73-1754) 250-kG MIRROR COIL DEVELOPMENT FOR THE LINEAR SCYLLAC EXPERIMENT. Hanks, K. W.; Boicourt, G. P.; Bailey, A. G. (Los Alamos Scientific Lab., N. Mex. (USA)). 1973. Contract W-7405-eng-36. 4p. (CONF-731114-39). Dep. NTIS $3.00.

From 5th symposium on engineering problems of fusion research; Princeton, New Jersey, USA (6 Nov 1973).

The linear Scyllac theta-pinch machine required mirror coils on each end of the 5-m-long lead coil, which would give mirror ratios of two to three times the 100-kG main coil magnetic field. A pulsed magnetic field of 250 RG was established as a design goal for the mirror coils. Several different designs were evaluated using the 178-kJ, 60-kV Scyllac prototype capacitor bank. Calculations were made to determine the coil geometry for each 250-kG coil design. A copper-lined, steel-jacketed coil, and an all steel coil were fabricated and tested (4 to 5 cm bores). The types of materials selected for each coil, strength considerations, and fabricating techniques are discussed. The final design of the mirror coils for the 11.2-cm-bore Scyllac machine was established using an all-steel (Maraging type 250) design. An aluminum coil (2014-T652) was built and tested to failure in order to establish data as to the maximum fields that aluminum coils could be subjected to in a typical pulsed theta-pinch environment. This program and conclusions are discussed. (auth)

14442 (ORNL-TM-4080) RELATIONS BETWEEN THE MAJOR SIZE AND COST PARAMETERS OF TOKAMAKS. Fraas, A. P. (Oak Ridge National Lab., Tenn. (USA)). Jan 1974. Contract W-7405-eng-26. 32p. Dep. NTIS $3.75.

A set of preliminary estimates of the effects of torus size on major design and cost parameters was made for a series of tokamak reactors with superconducting coils for the toroidal field. The three sets considered include essentially zero power scientific feasibility experiments, low-power reactor systems for plasma physics experiments, and full-scale power reactors. The prime concern is with the cost of the superconducting magnet coils, but allowances for the blanket and magnet shield systems are also included as well as the system for heating the plasma to the ignition temperature. The prime objective was to show trends for major parameters, not absolute values for costs. The results of the study indicate that the cost of a superconducting coil system for the toroidal field increases relatively little with torus diameter for a scientific feasibility experiment, is quite insensitive to torus size for a plasma physics test reactor, and actually falls off with increasing size for a full scale power reactor. These effects stem from the reduction in the magnetic field required associated with an increase in torus size together with the increase in the allowable current density in the superconductor material with a reduction in the design value for the magnetic field. The results indicate further that, for a modest increase in the cost of superconducting magnets for the toroidal field, it should be possible to build a feasibility experiment so that it can be converted readily into a plasma physics test reactor. (auth)

14443 (ORNL-TM-4439) FUSION REACTOR TECHNOLOGY STUDIES AT ORNL. Steiner, D. (Oak Ridge National Lab., Tenn. (USA)). Jan 1974. Contract W-7405-eng-26. 64p. Dep. NTIS $5.25.

The purpose of this document is to review the ORNL Fusion Reactor Technology Studies during the period June 1972 to October 1973. The studies described herein have been carried out by members of a number of ORNL divisions, including the Chemical Technology Division, the Metals and Ceramics Division, the Reactor Division, and the Solid State Division. Several of the efforts are jointly funded by the AEC Division of Controlled Thermonuclear Research (DCTR) and the AEC Division of Physical Research (DPR). Such efforts are indicated in the text. (auth)

14444 (ORNL-tr-2765) PROF. ALFVEN ON NUCLEAR FUSION: COMMENTS ON AN OPEN LETTER. Merton, A. (Institut fuer Reaktorsicherheit der Technischen Ueberwachungs-Vereine e.V., Cologne (F.R. Germany)). Apr 1972. Translation by M. Gerrard of IRS-S-6. 4p. Dep. NTIS $3.00.

In an open letter of September 2, 1970, to the Swedish Minister of Industry, Prof. Hannes Alfven, Nobel Prize Winner in 1970, posed the question whether the program of carrying out a program of construction of nuclear-fission reactors was justified. As a basis for his question, he mentioned that, with a high probability, in the near future nuclear fusion would be available as an energy source. Until then, however, the use of fossil fuels would be preferable to nuclear fuels in view of the risks which the latter hold for man and the environment. Some comments on this letter are presented for the following: (1) state of development, (2) economic yield, (3) plutonium production, (4) radioactivity leakage, (5) conventional fuels and, (6) control of fissionable materials. (MOW)

14445 (SLA-74-6006) METHODS OF OBTAINING LIMITING ELECTRICAL POWERS IN SHORT PULSES. Babykin, M. V.; Bartov, A. V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). Nov 1973. Translation of IAE-2253. 41p. Dep. NTIS $4.25.

A review of electromagnetic energy storage devices is given. The following topics are discussed: (1) transmission lines with constant wave impedance; (2) electrical lines with tapered wave impedance; (3) limiting values of the power of electric lines; (4) some properties of lumped-parameter systems—the aperiodic inductive storage device; and (5) limitation of current by the space charge and the matching of the energy source with the load. (MOW)

14446 (UCID-16418) "THETA FIELD LINER" CONCEPT. Shearer, J. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Dec 1973. Contract W-7405-eng-48. 21p. Dep. NTIS $3.25.

The implosion of a metallic liner is analyzed algebraically, computed numerically, and discussed qualitatively—from the point of view of comparing an azimuthal B_θ magnetic field driver with the previously proposed axial B_z magnetic field driver. From all points of view, reasons are found for preferring the former (theta-field) concept. (auth)

14447 (UCRL-74923) REVIEW OF 2XIIB PROJECT. Anderson, C. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 Aug 1973. 12p. (CONF-731114-22). Dep. NTIS $3.00.

From 5th symposium on engineering problems of fusion research; Princeton, New Jersey, USA (6 Nov 1973).

A review is given of the 2X project, including project history and recent results, with the intent that both those new to CTR engineering and those people familiar with its progress will benefit. The current 2XII Program plan is reviewed, with emphasis on the major device fabrication underway at the present time. This construction consists primarily of a new magnet for 2XII, and has been designated 2XIIB. The injection of a 600-A neutral beam is described. The final portion of the paper is a progress report and a summary of cost estimates and scheduling. (auth)

14448 (UCRL-75003) 2XII-B PULSE COIL DESIGN. Bulmer, R. H.; Harvey, A. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 Aug 1973. 16p. (CONF-731114-27). Dep. NTIS $3.00.

From 5th symposium on engineering problems of fusion research; Princeton, New Jersey, USA (6 Nov 1973).

The design of the 2XII-B pulse coil system is presented. Development of the coil geometry is given as well as the results of magnetic field calculations. A discussion of the forces developed by this high-energy coil set and the electrical stress on the magnet insulation is presented. The results of materials selection for both the coil insulation and structure are included, and also a description of the fabrication procedure. (auth)

14449 (UCRL-75022) 200 AMP NEUTRAL BEAM SOURCE. Duffy, T. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 Aug 1973. 7p. (CONF-731114-33). Dep. NTIS $3.00.

From 5th symposium on engineering problems of fusion research; Princeton, New Jersey, USA (6 Nov 1973).

Recent efforts in controlled fusion experiments have indicated the need for large neutral-beam sources to provide an initial plasma for further plasma buildup, for use as a stoking source to makeup losses, or for plasma heating. Experiments now operating or envisioned for the near future anticipate the need for kilo-amp neutral beams in the 20-keV energy range and higher. These sources will be required to focus into relatively small-volume targets, have good gas efficiency, and use a

minimum of excess gas for downstream neutralization. A test facility with sufficient pumping capacity to handle sources of this size is described. The ion source, mockup extraction grid, and the requisite electronic and power equipment for a 200-amp neutral-deuterium beam are discussed. The beam pulse length will be from 2 to 10 msec. (auth)

14450 (UCRL-75174) APPARATUS FOR TESTING DIRECT ENERGY CONVERSION OF PLASMA ENERGY TO ELECTRICITY. Barr, W. L.; Calderon, M. O.; Haratani, T. N.; Kinney, J. D.; Moir, R. W.; Smith, R. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Nov 1973. 13p. (CONF-731114-25). Dep. NTIS $3.00.

From 5th symposium on engineering problems of fusion research; Princeton, New Jersey, USA (6 Nov 1973).

The Lawrence Livermore Laboratory program for research and development of direct energy conversion for fusion reactor application is described. A new test facility consisting of a system of magnets, a vacuum chamber, and collector structure of unusual shapes and sizes is described. Under laboratory conditions, the anticipated collection efficiencies are 65% for a 2-stage venetian blind collector concept and 89 to 90% for a 22-stage periodic focussing concept. Because of space charge considerations, the venetian blind concept appears to be appropriate in the 100- to 200-keV ion energy range whereas the periodic focussing concept is more interesting in the 500- to 800-keV range. (auth)

14451 (WASH-1271) REVIEW OF THE RESEARCH PROGRAM OF THE DIVISION OF CONTROLLED THERMONUCLEAR RESEARCH. (USAEC, Washington, D. C.). Oct 1973. 266p. Dep. NTIS $7.60.

For CTR standing committee meeting; Cambridge, Massachusetts, USA (26 Apr 1973).

Each of the off-site contractors supported through the Office of Research and each of the four national laboratories supplied data about their research activities. A review concerning the following six activities is given: (1) plasma properties: equilibrium, stability, and transport, (2) plasma production and heating, (3) plasma measurements and instrumentation, (4) computer applications to CTR, (5) exploratory concepts in CTR, and (6) atomic, molecular, and nuclear physics in CTR. (MOW)

14452 (WASH-1278) CTR ENGINEERING SYSTEMS STUDY REVIEW MEETING, GERMANTOWN, MARYLAND, SEPTEMBER 19 AND 20, 1973. Gough, W. C. (USAEC Division of Controlled Thermonuclear Research, Washington, D. C.). 1973. 258p. (CONF-730971-). Dep. NTIS $7.60.

This is one of a series of review meetings being held in areas of advanced development and reactor technology important to the management of fusion power. The discussions covered the following areas: (1) reactor design studies, (2) conceptual studies, (3) cost-benefit studies, and (4) parametric systems analysis. (MOW)

14453 CONCEPT FOR A HIGH-POWER-DENSITY MIRROR FUSION REACTOR. Post, R.F.; Fowler, T.K.; Killeen, J.; Mirin, A.A. (Lawrence Livermore Laboratory, University of California, Livermore, California, 94550). Phys. Rev. Lett. 31: No. 5, 280-282 (30 July 1973).

A concept for a mirror-type fusion reactor based on recent advances in neutral-beam technology is shown to have improved plasma stability, a much higher power density, and a somewhat higher factor of energy gain Q, as compared with previous concepts using the magnetic-mirror principle. (auth)

14454 LONGITUDINAL ELECTRIC FIELD IN A GAUSSIAN BEAM NEAR FOCUS. Carter, W.H. (U.S. Naval Research Laboratory, Washington, D.C., 20375). Appl. Opt. 12: No. 8, 1732-1732 (Aug 1973).

The longitudinal electric yields produced by a laser beam near its focus are considered. This information is important in the study of laser induced thermonuclear fusion. (AIP)

14455 ON THE ANOMALOUS GENERATION OF NEUTRONS IN LASER PLASMAS. Katz, J.I. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). Appl. Phys. Lett. 23: No. 6, 342-343 (15 Sept 1973).

A nonthermal beam-target model is proposed to explain the anomalous generation of neutrons from laser plasmas. The model requires the presence of a multimicrosecond prepulse that generates an extended low-density gas cloud, and it predicts the effects of the addition of a background gas to the experiments. (auth)

14456 TRITIUM IN FUSION POWER REACTOR BLANKETS. Hickman, R. G. (Univ. of California, Livermore). Nucl. Technol.; 21: No. 1, 39-49(Jan 1974).

Several related problems involving the recovery of tritium from the breeding blanket in fusion power reactors are considered. They include the use of stagnant lithium blankets, the use of lithium as a regenerable getter pump, and the use of breeder materials that are lithium intermetallic alloys. Transient tritium recovery rates during startup are also estimated. Keeping the tritium inventory low and providing an economical recovery cycle are conflicting goals. These topics may provide a scheme by which both might be accomplished. (auth)

14457 SOME PROBLEMS OF FUSION REACTORS. Hogg, G. R. At. Energy Aust.; 16: No. 3, 7-13(Jul 1973).

Fusion reactions considered are the D-T reaction, the D-D reaction and the D-^{3}He reaction. The major difficulty in controlled thermonuclear research lies in the confinement of hot reacting plasma for a sufficient time. Three possible devices that could be used as controlled thermonuclear fusion reactors the Tokamak, the mirror machine and the theta pinch are discussed briefly. Some technical problems which may limit the attainment of fusion power are described. To outline some of the problems a hypothetical toroidal reactor, based on the Tokamak principle is considered. Problems associated with the development of a breeding blanket for a fusion reactor based on the D-T fuel cycle are described. Safety considerations are discussed. (AU)

14458 RESISTIVITY OF ST TOKAMAK. Ross, D.W.; Cardwell, G.L. (Center for Plasma Physics and Thermonuclear Research, The University of Texas at Austin, Austin, Texas 78712). Phys. Fluids 16: No. 9, 1551-1553 (Sept 1973).

The magnetic diffusion equation is solved for discharges in the ST tokamak, eliminating the need to define plasma lumped circuit parameters. Agreement with experiment is obtained if the mean ionic charge increases by 50% from the measured value during the first 25 msec. (auth)

Wave Phenomena

14459 (EP-RR-32, pp 22-26) WAVE PROPAGATION EXPERIMENTS AT FLINDERS. Brennan, M. H. (Flinders Univ. of South Australia). Oct 1972.

From plasma physics seminar-1972 meeting; Canberra, Australia (9 Mar 1972).

In the wave propagation program, the following topics are being investigated: (1) anomalous skin effect, (2) waves in plasma with two ion species; and (3) ion cyclotron waves. A brief outline of the shock-wave program is also given. (AT)

14460 (EP-RR-32, pp 27-36) PLASMA WAVES AND TURBULENCE. Hines, K. C. (Univ. of Melbourne). Oct 1972.

From plasma physics seminar-1972 meeting; Canberra, Australia (9 Mar 1972).

It is argued that the future for theoretical plasma physics will be increasingly in the study of nonlinear phenomena, wave-wave interactions, weak and strong turbulence. Attention is concentrated on plasma interactions with radiation and a description of some basic problems is presented. These include nonlinear interactions, between cyclotron harmonic waves with particular reference to the tokamak configuration. (auth)

14461 (KHFTI-73-15) FOUR-CANAL SVCH PLASMA ELECTROMAGNETIC EMISSION. Adamov, I. Yu.; Berezhnyi, V.; Kononenko, V. I. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1973. 7p. Dep. NTIS (U. S. Sales Only) $3.00.

An shf device for the investigation of the electromagnetic plasma emission on wavelengths of λ = 32, 16.8, and 4 mm is described. The investigation of amplitude, frequency, and temporal characteristics of hydrogenous plasma electromagnetic nonthermal emission in electrodeless induction discharges is described. (auth)

14462 (LRP-68-73) COLLISIONLESS ION ACOUSTIC SHOCK WAVES IN A TWO-COMPONENT PLASMA. Tran, M. Q.; Bitter, M.; Hirt, P. J. (Centre de Recherches en Physique des Plasmas, Lausanne (Switzerland)). Oct 1973. 14p. Dep. NTIS (U.S. Sales Only) $3.00.

The structure of stationary ion acoustic shocks in a two-component plasma was studied. Unlike the situation in a one-component plasma there exists an oscillatory structure of the trailing edge even for zero ion temperature due to the reflection of light ions. The wavelength and amplitude of these oscillations were calculated in dependence of the Mach number and the concentration of light ions. (auth)

14463 (LRP-69-73) NONLINEAR WAVE PROPAGATION FOR A SLIGHTLY INHOMOGENEOUS PLASMA. Weibel, E. S. (Centre de Recherches en Physique des Plasmas, Lausanne (Switzerland)). Oct 1973. 11p. Dep. NTIS (U.S. Sales Only) $3.00.

A medium which may be slightly inhomogeneous in space and

time is characterized by its current response. A system of equations describing the linear and nonlinear coupling of WKB modes is derived. (auth)

14464 (N-73-31651) TURBULENCE IN ELECTROSTATIC ION ACOUSTIC SHOCKS. Means, R. W.; Coroniti, F. V.; Wong, A. Y.; White, R. B. (California Univ., Los Angeles (USA). Dept. of Physics). May 1973. Contract AT(04-3)-34. 61p. (NASA-CR-135490; PPG-149). NTIS $5.25.

Three types of collisionless electrostatic ion acoustic shocks are investigated using a double plasma (CP) device; (1) laminar shocks; (2) small-amplitude turbulent shocks in which the turbulence is confined to be upstream of the shock potential jump; and (3) large-amplitude turbulent shocks in which the wave turbulence occurs throughout the shock transition. The wave turbulence is generated by ions reflected from the shock potential; linear-theory spatial-growth increments agree with experimental values. The experimental relationship between the shock Mach number and the shock potential is shown to be consistent with theoretical shock models that assume that the electrons are isothermal. Theoretical calculations that assume a trapped electron equation of a state and a turbulently flattened velocity distrubution function for the reflected ions yields a Mach number vs potential relationship in agreement with experiment. (STAR) (auth)

14465 ION CYCLOTRON AND FAST HYDROMAGNETIC WAVE GENERATION IN THE ST TOKAMAK. Hosea, J.C.; Hooke, W.M. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey, 08540). Phys. Rev. Lett. 31: No. 3, 150-153 (16 July 1973).

A test coil operating at 25 MHz is used to generate waves in the vicinity of the ion-cyclotron frequency and its harmonics in the ST tokamak. Coil-loading and magnetic-probe signals show that propagating natural modes are excited efficiently in this plasma torus for both slow (ion cyclotron) and fast hydromagnetic waves. These data permit the formulation of an empirical model for wave propagation in the toroidal plasma. (auth)

14466 NUMERICAL INVESTIGATION OF THE FREE OSCILLATIONS OF AN INHOMOGENEOUS AXISYMMETRIC PLASMA COLUMN. Hewett, D. W. Lawrence, KS; Univ. of Kansas (1973). 169p. University Microfilms Order No. 73-30,820.

Thesis (Ph. D.).

The subject of this dissertation is the numerical time integration of the Vlasov equation as applied to an axisymmetric, inhomogeneous plasma. The nonlinear development of small coupled oscillations in the axial and radial directions is followed for both stable and unstable initial conditions. These oscillations are excited by perturbing the inhomogeneous equilibrium. The plasma is contained radially within an external surface through which external fields may be imposed. Axially, the plasma is bounded by a perfectly reflecting boundary on each end of the periodicity length. Techniques are presented whereby all six components of the electric and magnetic field may be self-consistently included; although purely electromagnetic modes are neglected. Results obtained for the stable electrostatically contained column indicate that the oscillation frequency of the axial electric field decreases as the radial inhomogeneity increases. This frequency also decreases, for given inhomogeneity, as one moves out in radius to more tenuous regions—though not as much as one would expect due to the decrease in density alone. Conversely, the decay rate of axial electric field oscillation increases with the inhomogeneity. The radial electric field oscillates with a higher frequency than the axial field evaluated at the same radius. Due to coupling and phase mixing, the radial field may not start exponential decay until after several oscillations for some axial wavenumbers. The unstable electrostatic column becomes more stable with increasing inhomogeneity. Results indicate that a sufficiently strong radial inhomogeneity will completely stabilize the instability due to axial counterstreaming for the relative streaming velocity used in this investigation. For inhomogeneity not great enough to completely stabilize the column, the axial electric field at points near the axis grows more slowly than the homogeneous result. Both the growth rate and amplitude of the axial field diminish with radius. The radial electric field near the axis will in general undergo substantial fluctuations and many, for small wavenumbers, even oscillate for a short time. The axial field settles to small, highly damped oscillations about an exponential growth line in relatively short time. The radial component near the axis has a much larger growth rate than the corresponding axial field. In contrast to the homogeneous case, a minimum unstable wavenumber greater than zero appears to exist. The maximum unstable wavenumber for the axial field decreases from the homogeneous result of unity; however, the radial component does not appear to be similarly stabilized. For values of the wavenumber approaching unity, the radial electric field differs in sign between points near and far from the axis though the amplitudes grow exponentially at approximately the same rate. Thus, it appears that the axial field in the unstable case is stabilized due to the growth of radial fields in the limit of wavelengths approaching a Debye length. (Diss. Abstr. Int., B)

14467 AN EXPLOSIVE SHOCK TUBE. Voitenko, A.E.; Lyubimova, M.A.; Matochkin, E.P. (Institute of Nuclear Physics, Siberian Branch, Academy of Sciences of the USSR). High Temp. 10: No. 6, 1149-1152 (July 1973).

Experiments with a model explosive shock tube are described. Flow of a dense air plasma with speed 25–10 km/sec is obtained by means of an explosive gas compressor. Photographs of flow over models were taken when the flow behind the shock wave becomes opaque. The experiments were conducted in a laboratory explosion chamber. (auth)

14468 MASS OF A WAVE PACKET IN PLASMA. Klima, R.; Petrzilka, V. A. (Inst. of Plasma Physics,Prague). Czech. J. Phys.; 23: No. 11, 1196-1201(1973).

The relativistic mass density which is transported by a quasi-monochromatic transverse wave packet is derived. The wave packet is assumed to propagate in isotropic cold collisionless plasma. The co-ordinate frame moving with the group velocity appears as the rest frame for both the mass density and the total mass of the wave packet. The equivalence of the energy–mass relation and the dispersion equation is demonstrated. (auth)

14469 STUDY OF THE PROPAGATION OF ION ACOUSTIC WAVES IN A WEAKLY IONIZED PLASMA. Cussenot, J.R.; Fabry, M. (Laboratoire de Physique des Milieux Ionisés, Université de Nancy I, 54 037 Nancy, France). Phys. Fluids 16: No. 9, 1538-1540 (Sept 1973).

This study of ion acoustic waves in a low density plasma is based on a theoretical model which takes into consideration ion collisions and ion drift velocity. (auth)

14470 WAVE-WAVE CONTRIBUTION TO THE HIGH-FREQUENCY RESISTIVITY OF NONEQUILIBRIUM PLASMA. Hirshfield, J.L. (Racah Institute of Physics, The Hebrew University of Jerusalem, Israel). Phys. Fluids 16: No. 9, 1460-1463 (Sept 1973).

A theory is given for that part of the high-frequency plasma resistivity attributable to the pairwise excitation of electrostatic waves. A class of nonequilibrium states is considered with arbitrary values of the electron-to-ion temperature ratio, and of the relative electron-to-ion drift speed (short of instability). Numerical results are presented and compared with earlier work, where various approximations had been used to account for ion dynamics. (auth)

14471 FILAMENTATION AND TRAPPING OF ELECTROMAGNETIC RADIATION IN PLASMAS. Kaw, P.; Schmidt, G.; Wilcox, T. (University of California, Los Angeles, California 90024). Phys. Fluids 16: No. 9, 1522-1525 (Sept 1973).

It is shown that an electromagnetic wave interacting with a plasma is subject to instabilities leading to light filamentation. Nonlinear solutions for light filaments and light trapping are also investigated. (auth)

14472 EXPERIMENTS ON ION-ACOUSTIC SOLITARY WAVES. Ikezi, H. (Institute of Plasma Physics, Nagoya University, Nagoya, Japan). Phys. Fluids 16: No. 10, 1668-1675 (Oct 1973).

Ion-acoustic solitary wave (solitons) have been studied experimentally by employing a double-plasma device. The solitary waves are found to be produced from both a single compressional pulse and a continuous wave. A rarefaction pulse also produces solitons if the pulse width is sufficiently wide. A theory based on the Schrödinger equation accounts for the number of solitons. Recurrence to the original state is observed when a continuous wave is launched. A simple wave-wave coupling analysis for the recurrence of the original state is given. (auth)

14473 RESONANT EXCITATION OF ELECTROSTATIC MODES WITH ELECTROMAGNETIC WAVES. Schmidt, G. (Department of Physics, University of California, Los Angeles, California 90024). Phys. Fluids 16: No. 10, 1676-1679 (Oct 1973).

Two electromagnetic waves, propagating in opposite directions, can resonantly excite electron or ion waves, if the difference frequency $\Delta\omega$ and wave number Δk satisfy the linear dispersion relation of such modes. This process damps the higher-frequency electromagnetic wave and amplifies the lower-frequency one (nonlinear Landau damping). The amplitude of the electrostatic mode may be limited by Landau damping, trapping, or by loss of resonance due to the frequency shift of the electromagnetic modes. (auth)

14474 ENHANCED INCOHERENT SCATTERING AT THE UPPER-HYBRID RESONANCE. I. COLD PLASMA THEORY. Fidone, I. (Department de la Physique du Plasma et de la Fusion Contrôlée, Centre d'Etudes Nucléaires, Association Euratom-CEA, 92-Fontenay-aux-Roses, France). Phys. Fluids 16: No. 10, 1680-1684 (Oct 1973).

Incoherent scattering of microwaves at the upper-hybrid resonance in

an inhomogeneous plane-layered plasma is investigated. The incident and scattered waves propagate in the plane characterized by the directions of the density gradient and the externally imposed magnetic field. The frequency of the waves is close to the cyclotron frequency and therefore full account of the dispersive properties of the plasma is taken. The principal aim of the study is the investigation of collective effects on the scattered flux of energy in a toroidal machine and therefore the case of accessible resonance and frequency shift of the order of the ion frequency are specifically considered. Except in the spectrum of the density fluctuations, thermal effects are neglected. This is the collision-dominated case. The relevant equations are solved for the case of opaque plasma and the scattered flux of energy is estimated. The result obtained indicates that enhancement of the scattering cross section with respect to the transparent scattering is expected for $\nu/\omega \ll 1$, where ν is the electron collision frequency. (auth)

14475 ENHANCED INCOHERENT SCATTERING AT THE UPPER-HYBRID RESONANCE. II. WARM PLASMA THEORY. Fidone, I.; Granata, G. (Départment de la Physique du Plasma et de la Fusion Contrôlée, Centre d'Etudes Nucléaires, Association Euratom-CEA, 92-Fontenay-aux-Roses, France). Phys. Fluids 16: No. 10, 1685-1691 (Oct 1973).

Incoherent scattering of microwaves at the upper-hybrid resonance in an inhomogeneous stratified warm plasma is investigated. The incident and scattered waves propagate in the plane characterized by the directions of the density gradient and the externally static magnetic field. Ordinary collisions are neglected and finite Larmor radius corrections in the dielectric tensor are taken into account. The structure of the incident wave field near the hybrid layer is discussed, and it is shown that the component of the incident Poynting vector along the density gradient is totally converted into Bernstein plasma waves. The energy flux of the scattered radiation is also calculated. The result obtained indicates that for T/mc^2 enhancement with respect to the usual high-frequency scattering ($\omega > \omega_p, \omega_c$) is expected. (auth)

14476 NONQUASINEUTRAL THEORY OF ION-ACOUSTIC RESONANCES IN BOUNDED NONUNIFORM PLASMAS AND COMPARISON WITH EXPERIMENTS. Weynants, R.R.; Messiaen, A.M.; Vandenplas, P.E. (Laboratoire de Physique des Plasmas, Association "Euratom-Etat Belge", Ecole Royale Militaire-1040, Brussels, Belgium). Phys. Fluids 16: No. 10, 1692-1705 (Oct 1973).

A theory is developed of ion-acoustic resonances in inhomogeneous plasmas of the positive column type using a fluid plasma description. Poisson's equation is properly taken into account, instead of applying the usual assumption of wave quasineutrality. The order of the differential equation describing the wave is thereby increased by two and the singularity that previously occurred as a result of the presence of a sheath region is thereby removed. It is shown that ion-acoustic resonances are confined within the plasma core, the effective boundary not being the wall, but the region in the plasma where the macroscopic ion flow velocity attains the Bohm velocity $(KT_e/m_i)^{1/2}$. The theoretical predictions are substantiated by a number of experiments taken from the literature and supplemented by a series of new experiments. The theory sheds new light on the problem of wave reflection from a negatively polarized wall and the damping of ion-acoustic waves propagating in inhomogeneous plasmas. (auth)

14477 LASER LIGHT FORCES AND SELF-FOCUSING IN FULLY IONIZED PLASMAS. Shearer, J.W.; Eddleman, J.L. (University of California, Lawrence Livermore Laboratory, Livermore, California 94550). Phys. Fluids 16: No. 10, 1753-1761 (Oct 1973).

A derivation is given for the nonrelativistic equation of motion of a fully ionized isothermal plasma in the presence of an intense electromagnetic wave, such as laser light. The result can be expressed in a form similar to an equation used in the microwave confinement of plasmas. Applications of the result are made to the evaluation of self-focusing effects. The forces exerted on the plasma are found to be significant magnitude at contemporary intensity levels for neodymium laser radiation at $\lambda = 1.06$ μm. (auth)

14478 STUDY OF ION ACOUSTIC WAVE DAMPING THROUGH GREEN'S FUNCTIONS. Hsuan, H.C.S.; Jensen, V.O. (Danish Atomic Energy Commission, Research Establishment Risø, Roskilde, Denmark). Phys. Fluids 16: No. 10, 1776-1778 (Oct 1973).

Green's function analyses of ion acoustic waves in streaming plasmas show that, in general, the waves damp algebraically rather than exponentially with distance from exciter. (auth)

14479 STIMULATED TEMPERATURE SCATTERING OF ELECTROMAGNETIC WAVES IN A PLASMA WITH COLLISIONS. Mityakov, N. A.; Rabinovich, M. I.; Rapoport, V. O.; Shtil'man, L. E. (Scientific-Research Radiophysics Inst., Gorky, USSR). Zh. Eksp. Teor. Fiz.; 65: No. 5, 1893-1897(Nov 1973). (In Russian).

It is shown that, in a plasma layer whose imaginary part of the dielectric permeability depends on temperature, the interaction of electromagnetic waves with close frequencies leads to effects similar to the well-known process of stimulated temperature scattering. A periodic temperature profile is established on resonant interaction, and its presence appreciably alters the nature of electromagnetic-wave absorption in the plasma. Since the medium is nonlinear with respect to the temperature wave, the shape of the latter in many cases strongly differs from a sinusoidal one and qualitatively alters the general pattern of spontaneous scattering of electromagnetic waves. (auth)

14480 STRUCTURE OF NONLINEAR WAVES PRODUCED WHEN INSTABILITY DEVELOPS IN ION-ION OR ELECTRON-BEAM PLASMA. Gabovich, M. D.; Gladkii, A. M.; Kovalenko, V. P.; Kozyrev, Yu. N.; Naida, A. P. (Inst. of Physics, Kiev). JETP Lett. (USSR) (Engl. Transl.); 18: No. 6, 202-204(20 Sep 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 6, 343-347(20 Sep 1973).

The electric field of a nonlinear wave excited in a synthesized ion-ion or electron beam-plasma system, and connected with the bunching of the charged particles and their capture by the wave field, was measured directly for the first time. (auth)

14481 TRANSITION SCATTERING. Ginzburg, V. L.; Tsytovich, V. N. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz.; 65: No. 5, 1818-1824(Nov 1973). (In Russian).

The propagation of various types of waves (longitudinal acoustic, plasma, etc.) in a media involves the presence of a dielectric susceptibility wave. When such a wave is incident on a resting ("fixed") charge, electromagnetic radiation is emitted, irrespective of the presence of an electromagnetic field in the incident wave. The intensity of such "transition scattering" is calculated. A more general statement of the problem is mentioned, and it is pointed out that transition scattering may be of interest not only in plasma physics but in physics of other media as well. (auth)

14482 NONLINEAR TRANSFORMATION OF RADIATION INTO PLASMA WAVES. Pustovalov, V. V.; Silin, V. P.; Tikhonchuk, V. T. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz.; 65: No. 5, 1880-1892(Nov 1973). (In Russian).

The stationary spectral distribution and electric field strength of high-frequency plasma waves (plasmons) are determined by analyzing and solving the nonlinear integral equation. The plasma waves are assumed to be parametrically excited by an intense nonpotential pumping in a homogeneous isotropic plasma for a pumping field frequency close to the double electron Langmuir frequency. The nonlinear mechanisms of saturation of the noise level leading to a stationary turbulent state of the initially parametrically unstable plasma are induced scattering of plasma waves by ions and nonlinear frequency shift of the plasma waves. The coefficient of nonlinear transformation of the pumping radiation into plasma waves reaches a value of the order of unity when the pumping flux only slightly exceeds the threshold value. (auth)

PHYSICS (RADIATION AND SHIELDING)

Radiation Physics

Refer also to abstracts 12874 and 13747.

14483 (INIS-mf-868) SOME RECENT ADVANCES IN "ASFIT". Gopinath, D. V.; Santhanam, K.; Burte, D. P. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 6p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

"ASFIT" is a semianalytical method based on collision probabilities for energy dependent radiation transport. In its original form, the coupled integral equations for space and energy-angle transmission are solved using discrete ordinate representation in space and energy and polynomial approximation in direction cosine for radiation flux and source terms. The following modifications of ASFIT are presented: a) discrete ordinate representation in direction cosine, b) sequential integration in space, c) exponential transformation in space, and d) multiple energy structure for neutron transport. The rationale for these modifications, their effect on the speed of computation, convergence and capabilities of the code are also discussed. (auth)

14484 (SC-RR-72-683) EFFICIENT COMPUTER ACCESS TO THE SANDIA PHOTON CROSS SECTIONS. Adams, K. G.; Biggs, F. (Sandia Labs., Albuquerque, N. Mex. (USA)). Dec 1973. Contract AT(29-1)-789. 67p. Dep. NTIS $5.50.

The computer program SIGMA is described and illustrated. This program provides photon cross sections for use in various kinds of engineering problems, as well as some routines for processing cross sections for use in transport codes. A brief description is given of the analytical approximations used to obtain numerical values of the cross sections. SIGMA is available on permanent files for use on the CDC 6600. (auth)

14485 STOPPING POWERS AND RANGES FOR MUONS, CHARGED PIONS, PROTONS, AND HEAVY IONS. Armstrong, T. W.; Chandler, K. C. (Oak Ridge National Lab., TN). Nucl. Instrum. Methods; 113: No. 2, 313-314(1973).

A computer program for calculating stopping powers and ranges for muons, charged pions, protons, and heavy ions in any nongaseous medium at energies from zero to several hundred GeV is discussed. (auth)

14486 OPTIMIZATION OF IRRADIATION PLANNING IN ^{60}Co TELETHERAPY. Reproducibility of Focussing. Popp, F. A.; Busch, M. (Univ., Marburg, Ger.). Strahlentherapie; 146: No. 2, 190-197(1973). (In German).

The sensitive dependence of the complication and healing rate on the absorbed energy dose in radiotherapy requires a consequent optimization of irradiation planning. Preconditions to this optimization are objective criteria for the judgement of the irradiation plan. After the reference to a quantitative measure for the judgement of isodose representation, the reproducibility of the field focussing is examined. The derived formulas allow the calculation of the probability for given dose deviations from the normal value, due to inevitable faults in focussing and movements of the patients. (auth)

14487 SOME MODIFICATIONS IN THE ANISOTROPIC SOURCE-FLUX ITERATION TECHNIQUE. Gopinath, D. V.; Santhanam, K.; Burte, D. P. (Bhabha Atomic Research Centre, Bombay). Nucl. Sci. Eng.; 52: No. 4, 494-498(Dec 1973).

The Anisotropic Source-Flux Iteration Technique (ASFIT) is a semianalytical method based on collision probabilities for energy-dependent radiation transport. In its original form, the coupled integral equations for space and energy-angle transmission were solved by using discrete ordinate representation in space and energy and polynomial approximation in direction cosine for radiation flux and source terms. In this note, the following modifications of ASFIT are presented: discrete ordinate representation in direction cosine, sequential integration in space, exponential transformation in space, and multiple energy structure for neutron transport. The rationale for these modifications and their effect on the speed of computation, convergence, and capabilities of the code are discussed. (3 figures) (auth)

14488 ALPHA-PARTICLE STOPPING CROSS SECTION OF SOLIDS FROM 0.3 TO 2.0 MeV. Lin, W.K.; Olson, H.G.; Powers, D. (Baylor University, Waco, Texas 76703). Phys. Rev. B 8: No. 5, 1881-1888 (1 Sept 1973).

Stopping cross sections of α particles for 12 solid elements Se, Y, Zr, Nb, Mo, Sb, Te, La, Dy, Ta, W, and Au have been measured for $0.3 \leq E_\alpha \leq 2.0$ MeV. Structure additional to that previously obtained was observed, in the periodic dependence of the stopping cross section on the atomic number of the stopping element. Good agreement in the periodic dependence of the structure was found when the experimental results were compared to theoretical calculations based on Lindhard's statistical approach, carried out by Rousseau, Chu, and Powers. The energy dependence of stopping cross section was examined by fitting the experimental results to a three-parameter formula recently suggested by Brice. The usefulness of this formula in extrapolating the results to energy regions outside the measurements is investigated. (auth)

14489 STOPPING POWER OF 1-9-MeV He^{++} IONS IN UO_2, $(U, Pu)O_2$, AND ThO_2. Nitzki, V.; Matzke, H. (European Institute for Transuranium Elements, Euratom, D-75 Karlsruhe, Postfach 2266, Germany). Phys. Rev. B 8: No. 5, 1894-1900 (1 Sept 1973).

The stopping power and the range of He^{++} ions with energies between about 1 and 9 MeV have been measured for the oxides of nuclear interest UO_2, $(U, Pu)O_2$, and ThO_2, using a new and versatile method. The experimental technique consisted in evaporating oxide layers onto a source emitting α particles of five different energies, and then determining dE/dx by α spectroscopy. These multienergy sources could conveniently be obtained by exposing a metal foil to the recoil atoms of Th^{228}, the radioactive decay chain of which contains five daughter nuclides with different α energies. In addition, the α spectra of thick homogeneous samples were also evaluated and yielded confirmatory results. The data are compared to theoretical calculations. and their application in self-diffusion studies is discussed. (auth)

14490 STOPPING POWER OF Al, Cu, Ag, Au, Pb, AND U FOR 3-18-MeV PROTONS AND DEUTERONS. Sørensen, H. (Physics Department, Danish AEC Research Establishment Risö, DK-4000 Roskilde, Denmark); Andersen, H.H. Phys. Rev. B 8: No. 5, 1854-1863 (1 Sept 1973).

The stopping power of Al, Cu, Ag, and Au has been measured for 9-18-MeV protons and deuterons in order to extend earlier Risö measurements covering the energy range 3-12 MeV. Furthermore, the stopping power of Pb and U was measured in the energy range 3-18 MeV. The standard deviation of the new data for the first four materials is 0.4%, while for Pb and U it is 0.6% and 0.8%, respectively. The mean excitation potential for copper is deduced to be 319.8 ± 3.2 eV, in good agreement with our earlier results. Excitation potentials for Ag, Au, U, and Pb are also extracted from the data. The results for the Pb and U support the view that the ratio between the mean excitation potential and the atomic number (the Block "constant") is an oscillatory function of the atomic number. (auth)

14491 ANALOG MONTE CARLO STUDIES OF ELECTRON PHOTON CASCADES AND THE RESULTANT PRODUCTION AND TRANSPORT OF PHOTO NEUTRONS IN FINITE THREE DIMENSIONAL SYSTEMS. Hansen, E. C. Troy, NY; Rensselaer Polytechnic Inst. (1973). 210p. University Microfilms Order No. 73-27,209.

Thesis (Ph. D.).

A major computer program KRIS-I has been written to perform analog Monte Carlo studies of electron photon cascades and the resultant production and transport of photo neutrons in finite three-dimensional systems. It is programmed in FORTRAN IV as a hierarchy of overlays of replaceable subroutines. The KRIS-I program can treat the transport of electrons, photons, positrons, and/or neutrons in complex multi-media three dimensional geometries with general quadric surfaces over arbitrarily chosen energy ranges. It combines a simple but accurate procedure for sampling from an arbitrary differential probability distribution with efficient cross-section representations to perform complicated single particle or many particle studies in an extremely fast and efficient machine calculation. (MHR)

14492 UNIFORMLY VALID ASYMPTOTIC SOLUTION TO A VOLTERRA EQUATION ON AN INFINITE INTERVAL. Hanson, F.B. (Department of Mathematics, University of Illinois at Chicago Circle, Chicago, Illinois); Klimas, A.; Ramanathan, G.V.; Sandri, G. J. Math. Phys. (N.Y.) 14: No. 11, 1592-1600 (Nov 1973).

A Volterra equation on the infinite interval with a logarithmic kernel multiplied by a small parameter is analyzed. A Laplace transform solution is found; also, an approximate solution is given and proved to be uniformly asymptotic as the small parameter tends to zero for all time. The solution has an algebraic-logarithmic decay for large times. The Volterra equation is a model for the transport of charged particles in a random magnetic field. (auth)

14493 SIMULATION OF X-RAY DOSES. A Monte Carlo Program. von Doehren, F. R. (Univ., Mainz). (1973). vp. (In German).

From annual meeting of the Deutsche Gesellschaft fuer Biophysik; Juelich, Ger. (27 Sep 1973).

Using a Monte Carlo program, energy spectra are calculated in microranges of a target and the dependence of these spectra on the target geometry is determined. (GE)

14494 MICRODOSIMETRIC DETERMINATION OF THE MAXIMUM PERMISSIBLE CONCENTRATIONS FOR ^{125}I. Gavron, A.; Feige, Y. (Israel Atomic Energy Commission, Yavne). pp 28-36 of Proceedings of the 6th National Conference of the Israel Health Physics Society. Schlesinger, T. (ed.). Yavne, Israel; Israel Health Physics Society (1972). (In Hebrew).

From 6th national conference of the Israel Health Physics Society; Nahal Soreq, Israel (19 Dec 1971).

A significant portion of the energy released by the decay of ^{125}I is carried by low energy Auger and internal conversion electrons. The range of these electrons is much smaller than the thyroid cell dimensions, thus causing a nonuniform dose distribution even within an individual thyroid cell. The absorbed radiation dose at various locations within the cell delivered by the incorporation of ^{125}I into the thyroid gland was calculated. The effects of variations in the biological parameters on the locally absorbed dose were investigated. Choosing the dose rate at the cell–colloid interface as the limiting factor and making conservative assumptions a Maximum Permissible Thyroid Burden (MPTB) of 0.38 μCi ^{125}I for a 20 g gland was obtained. The corresponding MPC_a and MPC_w for radiation workers 4×10^{-9} and 3×10^{-5} μCi $^{125}I/cm^3$, respectively. (auth)

14495 STRUCTURAL PROPERTIES AND FINITE RANGE ELEMENTARY SOLUTIONS OF THE LINEAR BOLTZMANN EQUATION. Syros, C. (EURATOM, Brussels). Bull. Cl. Sci., Acad. Roy. Belg.; No. 6, 508-526(1973).

The natural solutions of the time- and energy-independent linear Boltzmann equation with isotropic scattering have been found on $A \otimes B^0$ where A is the interval [a,b] a,b > 0 and $B^0 = [-1,0[u]0,1]$. These functions are regular everywhere on $A \otimes B^0$ and they satisfy homogeneous or inhomogeneous boundary conditions. The solutions become uniformly continuous functions on $A \otimes B$ and have bounded derivatives of any order if the convention for taking limits, $x \xrightarrow{\lim} a,b\ z \xrightarrow{\lim} \pm 0\ \psi(x,z)$, is used. The construction of the solutions is based on a number of structural properties established by corresponding new theorems. They exhibit invariance properties with respect to translation, parity and scaling transformations. (auth)

14496 EFFECTS OF ENERGY LOSSES IN ALUMINUM ON ELECTRON-DIFFRACTION INTENSITIES. Kuwabara, S. (Saga Univ., Japan); Cowley, J. M. J. Phys. Soc. Jap.; 34: No. 6, 1575-1582(Jun 1973).

By use of a "Gegenfeld" filter the ratios of intensities of electron diffraction rings from evaporated aluminum films (100 ~ 550 Å in thicknesses) have been measured from various energy losses of the incident electrons. For elastic scattering and for 7 eV loss (surface plasmon loss) the intensity ratios show some effects of dynamical scattering. For 15 eV loss (volume plasmon loss) they are more nearly kinematical. For a narrow loss region at 3 eV and again at 10 eV the ratios show strong anomalies. These results are explained through intensity calculations based on n-beam dynamical diffraction theory. In particular, the anomalous intensity ratios are attributed to the effects of single-electron excitations in the crystals. (auth)

14497 USE OF JACOBI POLYNOMIALS FOR THE DESCRIPTION OF THE PROPAGATION OF GAMMA RADIATION. Broder, D. L.; Platovskikh, Yu. A.; Popkov, K. K.; Sergeev, I. V. Vestsi Akad. Navuk Belarus. SSR, Ser. Fiz.-Energ. Navuk; No. 1, 13-18 (1973). (In Russian).

A possibility of obtaining an approximate transport equation in the cylindrical geometry by Jacobi polymonial expansion of angle dependence, containing two arbitrary parameters, is shown. Distribution function and scattering kernel are represented by polynomials having different parameter values. A multigroup equations system is obtained. By using Jacobi polynomials the solutions of transport written in a modified coordinate system it is possible to describe the space-energy dependence of the radiation flux even in first approximation sufficiently well. (auth)

14498 INVESTIGATION OF THE ANGLE OF INCIDENCE IN CASE OF TWO ADJOINING FIELDS IN ^{60}Co TELETHERAPY IN ORDER TO OBTAIN A UNIFORM DOSE DISTRIBUTION IN VARIOUS DEPTHS. Ofosu-Barko, F. O. Heidelberg; Univ. Heidelberg (1973). 28p. (In German).

Thesis.

The field parameters normally available for single fields are limited in size for physical and technical reasons. Therefore, large foci cannot be irradiated with a single field. When using a series of several fields, however, there is the danger of overdosage or underdosage at the boundaries between the fields. Therefore, investigations have been made with dosimeter films on a phantom in order to determine the exact beam inclination and angle of incidence in ^{60}Co-gamma irradiation of two equal fields of 8 cm in length and 6 cm in width in order to obtain a uniform dose distribution at the field boundary in depths of 5 cm, 10 cm and 15 cm. Irradiation with a total angle below 9° between the two fields results in an overdosage, whereas irradiation with an angle below 10° results in a clear underdosage at the field boundaries. Uniform dose distribution over the entire length of the two fields without any under or overdosage at the field boundaries has been obtained by irradiation with an angle of 9.5°. (GE)

14499 DETERMINATION OF THE ION DENSITY PRODUCED BY SLOW ELECTRONS IN BIOLOGICALLY IMPORTANT SUBSTANCES. Cloos, O. Frankfurt am Main; Univ. Frankfurt am Main (1972). 7p. (In German).

Thesis.

An apparatus is described for the measurement of the specific ionization in various gases. A tele-focus cathode serves as a beam source and a beam controlling system has been developed to keep the influence of the slow intensity changes of the electron beam small. A transmission monitor diaphragm is used to record the fast intensity changes in the beam current. The currents are recorded by means of a newly developed, automatic compensation device in two separate measuring tracks, with an accuracy of ±1%. The gas pressure in the ionization chamber is kept constant over several hours with an accuracy of at least ±1% by means of an automatic dosaging valve. Different gases (air, oxygen, carbon monoxide, argon and hydrocarbons) are irradiated with electrons in the energy range 5 keV-10 keV and the specific ionization dI/rho x dx is measured. The number of ions produced by a primary electron over a certain range is related to the number of shell electrons. The values thus obtained for the ionization dI/n_e x dx are in good agreement, for all gases not containing hydrogen, with an accuracy of ±3% within the energy range 7 keV to 10 keV. The individual properties of the molecules are perceptible only at lower energies and at 5 keV, e.g., maximum deviations from the mean value of ±7% are recorded. A method is outlined to calculate the total electron ionization ability of a given substance consisting mainly of hydrogen, nitrogen, oxygen and carbon. The electron ionization ability for substances such as water, muscle tissue and bones, which are of particular importance from the biological and radiotherapeutical point of view, is calculated for the energy range 5 keV to 100 keV. (GE)

14500 DOSE DISTRIBUTION FOR COBALT-60 TANGENTIAL IRRADIATION OF THE BREAST AND CHEST WALL. Mansfield, C. M.; Suntharalingam, N. (Thomas Jefferson Univ. Hospital, Philadelphia). Acta Radiol., Ther., Phys., Biol.; 12: No. 1, 40-46 (Feb 1973).

The surface dose and the dose to underlying superficial layers for cobalt-60 tangential irradiation of the breast and chest wall areas have been measured. LiF-teflon disc dosimeters were used. Oblique incidence, surface curvature and the presence of special breast applicators influenced the dose distributions. (SW)

14501 DETERMINATION OF ELECTRON ENERGY LOSSES IN ABSORBERS: A STUDY OF THE ^{137}Cs SPECTRUM. Van De Geijn, S. C. (EURATOM, Wageningen, Netherlands). Nucl. Instrum. Methods; 114: No. 1, 135-136(1974).

In contrast with an earlier publication (R. A. Fjeld and K. Verghese, Nucl. Instr. and Meth. 93(1971)573) the energy loss of the 514 keV β-spectrum of ^{137}Cs after transmission through absorbers[2] is found to be in agreement with theory. (auth)

14502 POST-OPERATIVE RADIOTHERAPY OF THE MAMMARY CARCINOMA. Investigations of Optimum Dose Distributions for Irradiation of the Thoracic Wall by Means of Tangential Standing Fields. Part 1. Heilmann, H. P. (Univ., Tuebingen, Ger.). Strahlentherapie; 146: No. 2, 174-189(1973). (In German).

Experimental investigations are described that were carried out on a special water phantom with particularly thin walls as well as on a Machlett-Alderson-Rando-Man phantom in which the usual bore holes have been replaced by a point lattice of microbores with a lattice pitch of 1.5 cm. Dosimetric measurements were made ionometrically on the water phantom and for the Alderson phantom, TLD-100 dosemeters were used. The measured values were standardized by a computer program and printed out as isodoses. The superimposed isodoses were obtained by computational superposition of opposing fields and the mathematical variation of irradiation parameters (angle of incidence, etc.) allowed the examination of various irradiation procedures. Measurements were carried out using the kilovolt technique, with the tele-cesium device, the tele-cobalt device, and the 17-MeV betatron with ultrahard x-ray irradiation. Uniform irradiation of the thoracic wall with good or satisfactory protection of the lung can be obtained with the tele-cesium device and even better with the tele-cobalt device using ultrahard x rays, whereas in the conventional deep x ray therapy, the dose distribution is not satisfactory as the dose

applied to the region between the two fields is not sufficient. For tele-cesium and tele-cobalt irradiation, differences in dose distribution due to tissue inhomogeneities, measured in the Alderson phantom and compared with those obtained in the water phantom, could be detected but were too slight. Using the kilovolt irradiation however, considerable effects of inhomogeneities could be clearly detected prior to the superimposition of the standing fields. The conclusions to be drawn from these results with regard to practical radiotherapy are discussed and irradiation techniques are described that will allow reproducible irradiations to be made using the given isodoses. (GE)

14503 THYROID RADIOIODINE UPTAKE MEASUREMENTS USING A NECK PHANTOM. New York; American National Standards Institute, Inc. (1973). 8p. (ANSI–N44.3-1973).

This standard establishes a neck phantom and uniform procedure to be used for thyroid radioiodide uptake measurements. A reference activity, the method for its preparation and use, and performance parameters for the detection system to be employed in the uptake measurement are specified. A formula for calculating percentage uptake is given as well as a uniform method for making background activity corrections of the counts derived from the patient and from the phantom. Using this phantom and specified methodology, the requirement for uniform and valid test results is met. Additionally, the use of this standard will provide a basis for direct intercomparison of the results obtained by various laboratories and clinics. (auth)

14504 SURFACE-STATE TRANSITIONS OF SILICON IN ELECTRON ENERGY-LOSS SPECTRA. Rowe, J. E.; Ibach, H. (Bell Telephone Labs., Inc., Murray Hill, NJ). Phys. Rev. Lett.; 31: No. 2, 102-105(9 Jul 1973).

Surface-state transitions on ordered silicon (100)2 × 1 and (111)7 × 7 surfaces have been observed by electron energy-loss spectroscopy. The surface transitions were identified by comparing the clean ordered surfaces with clean disordered surfaces, and with disordered surfaces due to submonolayer quantities of absorbed oxygen. Three transitions are observed corresponding to surface states near the top, near the middle, and at the bottom of the valence band. These surface-state transitions are stronger on the (111)-7 × 7 surface than on the (100)2 × 1 surface. (auth)

14505 FREQUENCY DISTRIBUTIONS OF ENERGY DEPOSITION BY 44 MEV PROTONS AT BONE-SOFT TISSUE INTERFACES. Baily, N. A.; Steigerwalt, J. E.; Hilbert, J. W. (Univ. of California, San Diego, La Jolla). Radiat. Res.; 56: No. 2, 205-212(Nov 1973).

The frequency distributions of event size in the deposition of energy produced by the passage of protons in a pathlength of 6.99×10^{-5} g/cm^2 tissue equivalent gas have been measured after penetration of a 44 MeV monoenergetic proton beam through various amounts of bone and muscle equivalent plastic. Corresponding thicknesses of the absorbers of the two types were chosen such that the mean energy of the residual beam of protons entering the gaseous test volume was identical. Each pair of absorbers thus produced the same relative ionization density as measured by the Bragg curve. The points of the Bragg curve where data has been taken are: (1) where the ionization density has not yet started to increase sharply toward peak values; (2) at a point where the ionization density was rising steeply; and (3) at the maximum ionization density. The resultant energy deposition distributions obtained for each pair of the two absorbing materials were identical. This indicates that both primary and forward scattered secondary particle spectra in a degraded beam of low energy protons are not significantly different after the primary beam passes through equivalent amounts of bone or soft tissue. The results obtained on a microscopic scale are in agreement both with calculations of the absorbed dose and dose equivalent under similar conditions and with experimental measurements of absorbed dose. (auth)

14506 EVALUATION OF AIR-SCATTER EXPOSURE RATES OUTSIDE THE BOUNDARY OF A LARGE GAMMA GARDEN. Murthy, M. S. S.; Vyas, A.; Murthy, B. K. S.; Chandra, B. (Bhabha Atomic Research Centre, Bombay). Int. J. Appl. Radiat. Isotop.; 24: No. 12, 671-676(Dec 1973).

In the design and operation of installations such as γ gardens, exposure rates at large distances from the source have to be taken into account. In the present investigation, the exposure rates due to air scatter at positions several hundred metres away from a large ^{60}Co source have been calculated taking into account the build-up, the exponential attenuation and the energy spectrum of the scattered photons. These calculations were applied to a γ garden which has an 800-Ci ^{60}Co source fitted with a beam limiting lead plug and is surrounded by a thick granite wall. The role played by the height of the wall in modifying the exposure levels at various positions is also discussed. The calculated values have been compared with actual field measurements. (auth)

14507 INTENSITY OF FAST ELECTRONS TRANSMITTED THROUGH THICK SINGLE CRYSTALS. Ichimiya, A. (Nagoya Univ., Japan). J. Phys. Soc. Jap.; 35: No. 1, 213-223(Jul 1973).

It is shown theoretically that the intensity of diffuse background in electron diffraction patterns is mainly contributed from the multiple thermal scattering. At room temperature the intensity distribution in most cases is nearly the same as that of the multiple elastic scattering in amorphous materials. The theory is confirmed at accelerating voltages 100, 200 and 450 kV by measurements of intensities transmitted through silver single crystals of thicknesses from 0.05 μm to 1.2 μm. The mean and anomalous absorption coefficients measured at the (220) Bragg position at room temperature are $\mu_0 = 2.9 \times 10^{-3}$/Å and $\mu_{220} = 1.5 \times 10^{-3}$/Å at 100 kV, and $\mu_0 = 1.4 \times 10^{-3}$/Å and $\mu_{220} = 0.8 \times 10^{-3}$/Å at 450 kV. These results are in good agreement with the theoretical values in the literature. The maximum observable thickness for images of crystal imperfections is also calculated for some crystals, and the results are compared with experimental results. (auth)

14508 INTERPOLATION PROCEDURE FOR ENERGY DISSIPATION CURVES OF FAST ELECTRONS. Tabata, T.; Ito, R.; Okabe, S. (Radiation Center of Osaka Prefecture, Sakai, Japan). Annu. Rep. Radiat. Center Osaka Prefect.; 13: 59-64(Mar 1973).

Energy dissipation distributions of fast electrons calculated by Spencer have been fitted by a function with four adjustable parameters. The type of the electron source considered is plane perpendicular. The rms relative error, in which mean is taken with weights proportional to the square of the fitted value, is generally less than 2%, and is 2.8% in the worst cases. Values of the parameters determined are listed for all the entries in Spencer's table. By using these values, interpolation of Spencer's results in incident energy and absorber atomic number can be achieved simply and precisely. (auth)

Radiation Protection Standards

14509 HEALTH STANDARDS TO BE OBSERVED IN PLANNING INDUSTRIAL UNDERTAKINGS. Moscow; Izdatel'stvo Literatury po Stroitel'stvu (1972). 97p. (In Russian). 0.34 Rouble.

These standards apply to all new undertakings and work sites, as well as to those undergoing transformation, but not to underground work sites and temporary workplaces. They lay down specifications concerning choice of site and general planning, industrial premises and their equipment, heating, ventilation and air conditioning, water supply, waste removal, lighting, etc. Much scope is given to the classification of chemical and other works from the environmental pollution apsect. Lists of maximum permissible levels for toxic substances, microclimate, water pollution, noise, vibrations, ultra-sound, radio-frequency and ionizing radiations. [A commentary has been published in "Naučnye raboty institutov ohrany truda VCSPS", Moscow, 1972, No. 78, pp. 46-51.] (Occup. Saf. Health Abstr.)

Radiation Source Calibration and Standardization

Refer also to abstract 12783.

14510 PROCEDURE FOR ABSOLUTE STANDARDIZATION OF THE RADIOACTIVE PAIR ^{95}Zr/^{95}Nb. De Roost, E.; Hansen, H. H.; Van der Eijk, W.; Vaninbroukx, R. (Commission of the European Communities, Geel, Belg.). Int. J. Appl. Radiat. Isotop.; 24: No. 12, 702-705(Dec 1973).

The absolute standardization of a ^{95}Zr/^{95}Nb mixture is complicated because the half-lives of parent and daughter nuclei are comparable and a small but not negligible fraction of decays passes through an isomeric state in ^{95}Nb. A preferred decay scheme and decay data in the decay of ^{95}Zr-^{95}Nb-^{95}Mo are given. The activities of the three decaying states involved and their combinations are plotted as a function of time t after the initial isolation of ^{95}Zr. For any time t > 20 days it can be assumed that ^{95m}Nb is in a transient equilibrium with ^{95}Zr. By this the treatment of the theoretical formalism can be simplified. Measurements have been performed varying as much as possible different independent parameters, e.g., the dilution of the original radioactive material, the measuring methods and the procedure of the data treatment. The age of the primary solution and its specific activity have been roughly estimated by measuring during several days the total γ-ray counting rate and comparing the results with the time dependence of the theoretical total activity. The activity was determined by a 4πβγ coincidence method and a NaI(Tl) γ-ray spectrometer. Errors from all sources are discussed, from which it is deduced that a final error of 0.6% can be expected. (UK)

14511 DOSE CALIBRATOR PILOT STUDY. Garfinkel, S. B.; Hine, G. J. National Bureau of Standards Technical Note 791. Washington, DC; National Bureau of Standards (1973). 7p. GPO $0.30.

Results of measurements of six sources in dose calibrators used in nuclear medicine facilities at eight hospitals in the Washington metropolitan area are given. (auth)

Shielding Calculations and Experiments

Refer also to abstracts 13006 and 13290.

14512 (N-73-27579) DOPEX-1D2C: ONE-DIMENSIONAL, TWO-CONSTRAINT RADIATION SHIELD OPTIMIZATION CODE. Lahti, G. P. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Jul 1973. 31p. (NASA-TM-X-2836; E-7421). NTIS $3.00.

A one-dimensional, two-constraint radiation shield weight optimization procedure and a computer program, DOPEX-1D2C, is described. The DOPEX-1D2C uses the steepest descent method to alter a set of initial (input) thicknesses of a spherical shield configuration to achieve a minimum weight while simultaneously satisfying two dose-rate constraints. The code assumes an exponential dose-shield thickness relation with parameters specified by the user. Code input instruction, a FORTRAN-4 listing, and a sample problem are given. Typical computer time required to optimize a seven-layer shield is less than ½ minute on an IBM 7094. (auth)

PHYSICS (THEORETICAL)

General

Refer also to abstracts 13332, 14121, 14492, 15140, and 15143.

14513 (ITF-73-98-P) ASYMPTOTICALLY EXACT SOLUTIONS FOR FERMI SYSTEMS. Simenog, I. V. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1973. 24p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.25.

An investigation is made of Fermi-systems with a large number of particles for such cases of pair inter-particle potentials, which lead to collapsed systems. The fact that Hartree and Thomas–Fermi approximation is asymptotically exactly realized in the above-mentioned systems is proved. (auth)

14514 (ITF-73-104-P) CLEBSCH–GORDAN COEFFICIENTS OF THE GROUPS SO(n) AND U(n). Gavrilik, A. M. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1973. 28p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.50.

Some properties of the SO(n) and U(n) isofactors are considered. The recurrence relations for these isofactors are obtained which, together with the orthogonality and completeness relations, allow one to calculate the arbitrary isofactors of the above-mentioned groups. An explicit expression for the SO(n) isofactor, which couples three irreducible unitary representations of class I with respect to the subgroup SO(n–1), is obtained from the integral formula for an arbitrary SO(n) isofactor. (auth)

14515 (JINR-P2-7405) INFINITE-DIMENSIONAL ALGEBRA FOR THE GENERAL COVARIANCE GROUP AS A COMPLETION OF FINITE-DIMENSIONAL ALGEBRAS FOR THE CONFORMAL AND LINEAR GROUPS. Ogievetskii, V. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 8p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

It is shown that any generator of the general covariance group can be represented as some linear combination of repeated commutators of generators of the conformal and special linear groups. (auth)

14516 (JINR-P2-7434) LORENTZ-INVARIANT PHASE VOLUME TRANSFORMATION. Strel'tsov, V. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 8p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The questions discussed are concerned with the Lorentz-invariance of the ratio value of the volume element in the momentum space to the energy (E). It is shown that at a special choice of infinitely small vectors, forming the volume element, and of the vector p_{x_1} ($p_{x_4} = iE$) one can speak of the Lorentz-invariance of the value mentioned. At the same time the analogous statement with respect to the d^3p/E value can be made only for a limited number of cases and solely in the sense considered e.g., the p_y and p_z component invariance for relative motion along OX. (auth)

14517 (JINR-P2-7484) SIMPLEST BOUNDARY VALUE PROBLEMS FOR THE SCHROEDINGER EQUATIONS. Garchinski, V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The simplest, exactly solvable, boundary value problems for the Schroedinger equations are discussed. A short description of one-dimensional pseudoprocesses in terms of integral stochastic equations is given. (auth)

14518 MEASUREMENT OF THE RELATIVISTIC DOPPLER EFFECT USING 8.6–MeV CAPTURE γ RAYS. Olin, A.; Alexander, T.K.; Häusser, O.; McDonald, A.B. (Atomic Energy of Canada Limited, Chalk River Nuclear Laboratories, Chalk River, Ontario, Canada KOJ 1JO); Ewan, G.T. Phys. Rev. D 8: No. 6, 1633-1639 (15 Sept 1973).

The energies of γ rays from the 10.27–MeV ($T = 1$, $\Gamma < 1.8$ keV) → 1.63–MeV ($T = 0$) transition in ^{20}Ne have been measured in an annular Ge (Li) detector at 0 and 180 °. $^{16}O(^4He,\gamma)$ and $^4He(^{16}O,\gamma)$ capture reactions in a differentially pumped gas target were used to produce recoiling ^{20}Ne ions with two different very accurately known velocities. We observe a tranverse Doppler shift of 10.09 ± 0.41 keV for the ^{16}O capture reaction. This allows us to determine relativistic time-dilation effects at velocities of 0.05c to an accuracy of 3.5%. Our results are in very good agreement with the prediction of special relativity. (auth)

14519 SPACE-TIME QUANTIZATION AND CHERENKOV EMISSION AT VELOCITIES $v > c$. Meessen, A.; Bilocq, L. (Univ., Louvain, Belg.). Ann. Soc. Sci. Brux. Ser. I; 87: No. 3, 366-386(25 Oct 1973).

The value α of the ultimate limit for the smallest measurable distance should be considered as an unknown quantity, instead of assuming that $\alpha = 0$, as we do in our usual continuum theories. The corresponding generalization of our physical laws implies the use of finite-difference equations and a modification of Einstein's energy-momentum relation, with the conclusion that a material body can move at a velocity $v > c$, when $\alpha \neq 0$. The theory which was developed so far, and which applies only to free particles, is extended here to the case of interacting particles, to account for the Cherenkov radiation that will be emitted by any charged particle, moving at a velocity $v > c$. It is found that the usual quantum-mechanical selection rules for the energy and momentum variables are still valid when $\alpha \neq 0$, and that the spectral distribution of the emitted light can be predicted by means of a generalization of the usual classical theory of the Cherenkov effect. Some important implications with respect to the principle of relativity are also discussed. (auth)

14520 PRIMARY SINGULARITIES, ASYMPTOTIC WAVE FUNCTIONS AND UNITARITY IN THE THREE-BODY PROBLEM. Osborn, T.A. (Department of Physics, Brooklyn College of the City University of New York, Brooklyn, New York, 11210); Bollé, D. Phys. Rev. C 8: No. 4, 1198-1210 (Oct 1973).

This paper studies the singular pole structure present in the momentum space three-body-scattering wave functions. We prove that this structure alone is entirely responsible for the asymptotic behavior in coordinate space. We are also able to prove, without further assumptions, that the residues of each of the singularities in the wave function must be physical scattering amplitudes. We extend our study of these primary poles in three-body physics by using the singularity structure to obtain a derivation of the on-shell unitarity relations. (auth)

14521 NOTES ON THE 'NEW' EQUATION OF MOTION FOR CHARGED PARTICLES. Gupta, N.D.S. (Tata Institute of Fundamental Research, Bombay–5, India). Phys. Rev. D 8: No. 6, 1940-1941 (15 Sept 1973).

It is shown that, for the class of electromagnetic fields for which $\vec{E}.\vec{H} = 0$ and $|\vec{E}/\vec{H}|$ = constant, there is an exact integral of the equation of Mo and Papas. The exact solution of this equation for constant electric field is presented. The new equation and the Lorentz–Dirac equation reduce to each other when the radiation reaction is considered small. (auth)

14522 EXPRESSING OF THE TRANSFORMATION MATRICES IN TERMS OF 3nj COEFFICIENTS AND SOME 21j COEFFICIENTS. Kanyanskas, Yu. M.; Rudzikas, Z. (Inst. of Physics and Mathematics, Vilnyus, USSR). Liet. Fiz. Rinkinys; 13: No. 2, 191-205 (1973). (In Russian).

A method of the direct determination of the relations between the transformation matrices and 3nj-coefficients in the case of the successive coupling scheme is proposed. The corresponding expressions in the case of a number of 21j-coefficients are presented. The expressions of two new 21j-coefficients in terms of the lower order coefficients and their diagrams are given as well. The relations between the transformation matrices and 3nj-coefficients of the first and second kind for any $n \geq 3$ are given. (auth)

14523 RELATIVISTIC QUANTUM THEORY OF MEASUREMENT. Licht, A. L. Acta Univ. Wratislaviensis; 1: No. 164, 79-92(1972).

Some recent work on the theory of measurement of observables in finite space–time regions are reviewed. (JFP)

14524 COMMENT ON FIT TO EXPERIMENTAL DATA WITH EXPONENTIAL FUNCTIONS USING THE FAST FOURIER TRANSFORM. Smith, M. R. (Univ. of Calgary, Alberta, Can.); Cohn-Sfetcu, S. Nucl. Instrum. Methods; 114: No. 1, 171-173(1974).

The problems of applying the FFT algorithm to the method of Gardner et al; (J. Chem. Phys. 31(1959)978) for analyzing multi-component exponential decay curves are discussed. Improvements on Schlesinger's (Nucl. Instr. and Meth. 106(1973)503) approach are indicated. (auth)

14525 PARALLEL DISPLACEMENT WITHIN THE LIGHT CONE AND ITS APPLICATION IN THE ELECTRODYNAMICS OF CHARGES MOVING WITH THE VELOCITY OF LIGHT. Staruszkiewicz, A. (Jagiellonian Univ., Krakow). Int. J. Theor. Phys.; 8: No. 4, 247-252(1973).

It is shown that there exists on the light cone an affine connection which is metric, semisymmetric and locally integrable. There exists a correspondence between this connection and a system of charges moving with the velocity of light. The correspondence reveals in the case of commensurable charges a symmetry which disappears for non-commensurable charges. (auth)

14526 MOTION OF A CHARGED PARTICLE WITH RADIATION REACTIONS. Sen Gupta, N. D. (Tata Inst. of Fundamental Research, Bombay). Int. J. Theor. Phys.; 8: No. 4, 301-306 (1973).

The object of this paper is to show that initial acceleration is uniquely determined by the condition that the physical solutions of the Dirac-Lorentz equation are regular at $2e^2/3mc^3 = 0$. The method for obtaining this initial acceleration in the general case is given. (auth)

14527 TENSOR AND SCALAR DOMINANCE OF THE ENERGY–MOMENTUM TENSOR. Wess, J. (Univ., Karlsruhe, Ger.). pp 31-41 of Scale and Conformal Symmetry in Hadron Physics. Gatto, R. (Ed.). New York; John Wiley and Sons, Inc. (1973).

From scale and conformal symmetry in hadron physics meeting; Frascati, Italy (4 May 1972). See CONF-7205101-.

The idea of extending the group of general coordinate transformations in gravitational theories to include also conformal transformations is considered. It is noted that in such a theory the energy-momentum tensor and its trace play the role of currents, and dominance of the energy-momentum tensor by a spin-2 particle would be the analog to vector and axial vector dominance. A scheme is presented that allows these ideas to be formulated in the framework of Lagrangian field theories. The couplings of the pseudoscalar mesons to the f, f', and σ mesons are considered as an example. (LBS)

14528 THEORY OF BRUECKNER AND SAWADA APPLIED TO A MANY-BOSON MODEL. Razavy, M.; Krebes, E. S. (Univ. of Alberta, Edmonton). Can. J. Phys.; 51: No. 3, 292-301(1 Feb 1973).

The Bassichis–Foldy model of a simple interacting boson is solved numerically and the results are compared with those obtained by the Bogoliubov approximation and by the Brueckner–Sawada t-matrix formalism. In the normal region, contrary to the widely held view the Brueckner–Sawada approximation for the energy of the ground state is not reliable for strong, well behaved, repulsive forces. The Bogoliubov approximation, on the other hand, remains valid for a wide range of values of the coupling constant. In the inverted region, the attractive force causes a population inversion in the levels of the system. For this case a modified Brueckner–Sawada approximation is developed. This method is applied to the calculation of the transition point and the energies of the ground and the first excited states of the system. Most of the predictions of the modified Brueckner–Sawada approximation are quite accurate. By a simple change in the Bassichis–Foldy model it is shown that even for two bosons there can be a phase transition. In this model, the derivative of the ground state energy with respect to the coupling constant is discontinuous at the transition point. (auth)

14529 CRITICAL SCREENING PARAMETERS FOR THE GENERALIZED SCREENED COULOMB POTENTIAL. Iafrate, G. J. (Army Electronics Tech. and Devices Lab., Fort Monmouth, NJ). Phys. Rev., A; 8: No. 2, 1138-1141(Aug 1973).

An approximate expression for the critical screening parameters associated with the attractive generalized screened Coulomb potential (GSCP) is obtained by utilizing the variational principle and the virial theorem. Subject to certain conditions, this expression is shown to represent a lower bound to the true critical screening parameters associated with the GSCP. Specific results are reported for the bound states $n, l = n - 1$ of the Debye-Hückel potential and for the ground state and first excited state of the exponential-cosine screened Coulomb potential. (auth)

Quantum Field Theories

Refer also to abstracts 13789, 13857, 13858, 13876, 13919, 13938, 13979, and 13983.

14530 (COO-1112-189) QUANTIZATION AND GAUGE FREEDOM IN A THEORY WITH SPONTANEOUSLY BROKEN SYMMETRY. Yao, Y. P. (Michigan Univ., Ann Arbor (USA). Harrison M. Randall Lab. of Physics). May 1972. 50p. (UM-HE-72-16). Dep. NTIS $4.50.

A model with spontaneously broken symmetry in the asymmetrical gauge $\partial_\mu A^\mu = \kappa^2/m\,\Phi$ is quantized, where A_μ is the vector meson with mass m and Φ is the gauge excitation field. It is shown that κ^2 can be identified as the mass parameter of the Φ field, in addition to the numerical parameter ξ defined in the text. This implies that Φ is not a Goldstone boson. A renormalization gauge corresponds to any gauge with κ^2 finite. One can formally go over to the unitarity gauge by the limit $\kappa^2 \to \infty$. However, this limit should be taken with extreme care, so as not to interfere with the limits of internal loop integration. Several examples, including the anomalous magnetic moment of an electron, are given to illustrate that (a) physical quantities are gauge invariant, (b) the gauge with $\xi = 1$ and $\kappa^2 = m^2$ is particularly convenient for finite calculation, (c) ambiguities may arise if the $\kappa^2 = \infty$ is taken haphazardly, and (d) renormalization constants are gauge dependent and in some cases can be defined only for certain values of κ^2. (auth)

14531 (COO-1112-190) VERIFICATION OF MULTIPLICATIVE RENORMALIZATION OF A MODEL WITH SPONTANEOUSLY BROKEN SYMMETRY. Yao, Y. P. (Michigan Univ., Ann Arbor (USA). Harrison M. Randall Lab. of Physics). 1972. 12p. (UM-HE-72-34). Dep. NTIS $3.00.

The multiplicative renormalization program, performed in an Abelian gauge model with spontaneously broken symmetry, is verified explicitly at the one loop level. By utilizing the two parameter gauge freedom which was introduced in a previous note, the off-, as well as on-, mass-shell Green's functions can be made finite after renormalization. (auth)

14532 (JINR-P2-7328) INVARIANCE OF THE MAXWELL EQUATIONS WITH RESPECT TO THE GENERALIZED LORENTZ TRANSFORMATIONS. Strel'tsov, V. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 4p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

It is shown that the Maxwell equations are invariant with respect to transformations $x' = (x - v_1 t)\gamma_1$, $y' = y$, $z' = z$, $t' = (t - [v_2/(c_1c_2)]x)\gamma_2$, where $\gamma_1 = [v_1/v_2 - v_1/(c_1c_2)]^{-1/2}$, $\gamma_2 = (v_2/v_1)\gamma_1$, c_1 and c_2 are the velocities of the light propagation, while v_1 and v_2 are speeds of motion of a matter object in the forward and backward directions $[1/v_{1,2} = 1/v \pm (2\epsilon - 1)/c_0$ $(0 \le \epsilon \le 1)]$. In this case, e.g., the transformation formulas for the components of the electrical and magnetic field intensities (F^{ik}) have forms: $E'_x = E_x$, $E'_y = [E_y - (v_2/c)H_z]\gamma_2$, $E'_z = [E_z + (v_2/c)H_y]\gamma_2$, $H'_x = H_x$, $H'_y = [H_y + (v_1/c)E_z]\gamma_1$, $H'_z = [H_z - (v_1/c)E_y]\gamma_1$, where $c = (c_1c_2)^{1/2}$. (auth)

14533 GENERALIZATION AND INTERPRETATION OF DIRAC'S POSITIVE-ENERGY RELATIVISTIC WAVE EQUATION. Biedenharn, L.C.; Han, M.Y. (Physics Department, Duke University, Durham, North Carolina, 27706); van Dam, H. Phys. Rev. D 8: No. 6, 1735-1746 (15 Sept 1973).

We generalize Dirac's new equation so as to describe particles of mass m and arbitrary spin s. The same remarkable properties are found: positive energy, non-negative density, a conserved four-vector current, and the impossibility of minimal electromagnetic interaction. We show that the particles described by a subset of these equations are composites of two subparticles interacting by a relativistic action-at-a-distance interaction characterized by two harmonic oscillators. For these composite particles we find a linear relation between the square of the mass and the spin. We emphasize that the essential content of the generalized new Dirac equation is that it constitutes an example of a convariant solution for two interacting particles, and provides an explicit example of a new quantal subdynamics distinct from the (classical) front relativistic dynamics of Dirac. (auth)

14534 RENORMALIZATION AND GAUGE INDEPENDENCE IN SPONTANEOUSLY BROKEN GAUGE THEORIES. Appelquist, T.; Carazzone, J.; Goldman, T.; Quinn, H.R. (The Physics Laboratories, Harvard University, Cambridge, Massachusetts 02138). Phys. Rev. D 8: No. 6, 1747-1756 (15 Sept 1973).

We discuss the renormalization of spontaneously broken gauge theories in a large class of renormalizable gauges which includes the unitary gauge as a singular limit. Particular attention is paid to the constraints of gauge invariance on the renormalization program and to the gauge invariance and finiteness of the S matrix. Our intention is to supplement the formal discussions already in the literature by carrying out the renormalization program in an explicit and complete way (fixing counterterms and defining the physical parameters), and by restricting demonstrations of gauge invariance and finiteness to the one-loop level. The discussion is limited to an Abelian model for simplicity, and can easily be extended to more complicated gauge theories. All the essential features, however, are found already in the Abelian model. (auth)

14535 RENORMALIZATION GROUP AND AXIAL-VECTOR CURRENT IN TWO-DIMENSIONAL QUANTUM ELECTRODYNAMICS. Crewther, R.J.; Shei, S.; Yan, T. (Laboratory of Nuclear Studies, Cornell University, Ithaca, New York 14850). Phys. Rev. D 8: No. 6, 1730-1734 (15 Sept 1973).

An exactly soluble model of the renormalization group for two-dimensional quantum electrodynamics is presented. The theory has a nontrivial eigenvalue at which it is scale-invariant and some operators acquire anomalous dimensions. The anomalous constant associated with the axial-vector current is independent of coupling constant away from the eigenvalue, but vanishes at the eigenvalue. (auth)

14536 CONFORMAL WARD IDENTITIES IN MASSIVE QUANTUM ELECTRODYNAMICS. Nielsen, N. K. (Univ. of Aarhus, Denmark). Nucl. Phys.; B65: No. 2, 413-426(1973).

Integrated conformal Ward identities of the Callan–Gross–

Parisi type are derived in massive quantum electrodynamics, including external axial-vector currents, by means of the normal product formalism. It is found that conformal symmetry in the Gell–Mann–Low limit is violated for gauge-variant vertex functions through a mechanism which can be anticipated from classical field theory and from free field theory. (auth)

14537 RENORMALIZATION AND SECOND SHEET POLES IN UNSTABLE PARTICLE THEORY. Valent, G. (Ecole Polytechnique, Paris). Nucl. Phys.; B65: No. 2, 445-459(1973).

The renormalization of an unstable field is studied in the perturbative framework of Matthews and Salam. With the chosen coupling one has to face overlapping divergences: thus it is possible to generalize a result already obtained in super-renormalizable theories. In addition the existence of second sheet poles is studied. In perturbation theory Lagrange's theorem is used to prove their existence to all orders and it also gives an explicit formula to compute them. (auth)

14538 ν-DIMENSIONAL ANALYSIS OF THE SCHWINGER TERM. De Vega, H. J.; Girotti, H. O. (Universidad Nacional de La Plata). Lett. Nuovo Cim.; 8: No. 12, 721-724(17 Nov 1973).

An analysis of the Schwinger term is carried out through the extensive application of the ν-dimensional regularization scheme and a systematic use of distribution theory. It is shown that the extension of some aspects of quantum field theory to a space of continuous dimensionality gives rise to a rather formal but operative machinery from which the Schwinger term comes out naturally. As a by-product, it is also shown that the result obtained for this term depends, for arbitrary ν, upon the particular definition of the equal-time commutator between two field operators chosen as the starting point. (LBS)

14539 MASSLESS ϕ^4 THEORY IN 4-ϵ DIMENSIONS. Symanzik, K. (DESY, Hamburg). Lett. Nuovo Cim.; 8: No. 13, 771-774 (24 Nov 1973).

It is noted that the Green functions of massless ϕ^4 theory in 4-ϵ dimensions are in perturbation theory infra-red singular at certain positive rational ϵ. It is shown that, in the correct expansions of these functions, additional terms appear, whose infra-red singularities cancel the ones of perturbation theory. (LBS)

14540 WARD–TAKAHASHI–SLAVNOV IDENTITIES FOR ONE-PARTICLE IRREDUCIBLE VERTICES. Sarkar, S. (Imperial Coll. of Science and Tech., London). Lett. Nuovo Cim.; 8: No. 16, 933-936(15 Dec 1973).

Ward–Takahashi–Slavnov identities were recently formulated by Lee in terms of generating functionals for non-Abelion gauge theories. These results are analyzed and extended to the most general gauge theories. (LBS)

14541 TWO-COMPONENT FORMS OF THE DIRAC EQUATION. de Vries, E.; van Zanten, A.J. (Physics Department, Duke University, Durham, North Carolina 27706). Phys. Rev. D 8: No. 6, 1924-1928 (15 Sept 1973).

In this paper some aspects of the two-component alternative to the Dirac equation, recently proposed by Biedenharn, Han, and Van Dam (BHvD), are discussed. We consider the possibility that the BHvD equation can be interpreted as another two-component form of the Dirac equation, being brought about by a unitary transformation which resembles the Foldy–Wouthuysen transformation. This point of view also enables us to derive more two-component alternatives to the Dirac equation. (auth)

14542 COMPTON SCATTERING BY POLARIZED ELECTRONS AS A TEST OF QUANTUM ELECTRODYNAMICS. Stabler, R.C. (R. D. 2, Princeton, New Jersey, 08540). Phys. Rev. D 8: No. 6, 1932-1934 (15 Sept 1973).

The pairlike cross section for Compton scattering from polarized electrons is derived, and shown to differ slightly from the cross section obtained from the conventional matrix elements. The differences may enable an experimental test of the existence of the fieldlike interaction. (auth)

14543 CANONICAL CONFORMAL ANOMALIES. Chanowitz, M.S. (Stanford Linear Accelerator Center, Stanford, California 94305); Ellis, J. Phys. Rev. D 8: No. 6, 1917-1921 (15 Sept 1973).

We discuss the anomalies present in Ward identities for the conformal current assuming that products of hadronic currents have a canonical singularity structure at short distances. These canonical conformal anomalies arise in Ward identities involving two or three currents. Those associated with leading short-distance singularities can be represented by an anomalous term in the divergence of the conformal current $K_{\alpha\mu}(x)$: $\partial^\mu K_{\alpha\mu}(x) = 2x_\alpha \theta_\mu{}^{\mu\text{anomalous}}(x)$, where $\theta_\mu{}^{\mu\text{anomalous}}(x)$ also generates the canonical anomalies in trace identities. (auth)

14544 EQUAL-TIME COMMUTATOR OF CHARGE DENSITIES IN QUANTUM ELECTRODYNAMICS. Khare, A.V.; Pradhan, T. (Saha Institute of Nuclear Physics, Calcutta, India). Phys. Rev. D 8: No. 6, 1863-1867 (15 Sept 1973).

We show that one-electron and one-photon expectation values of the equal-time commutator of charge densities in quantum electrodynamics, which are usually assumed to be zero, contain δ-function derivatives of order $n \geq 4$ when evaluated in fourth-order perturbation theory. (auth)

14545 SOLUBLE TACHYON FIELD MODEL AND THE EQUIVALENCE THEOREM. Jue, C. (Department of Physics, Kyungpook National University, Taegu, Korea). Phys. Rev. D 8: No. 6, 1757-1764 (15 Sept 1973).

A soluble model of the tachyon field, which is relativistically invariant, is formalized with the restriction that tachyons are virtual particles. The coupling of a self-conjugate tachyon to a pair of spinless bradyons is investigated in a manner similar to Schweber's scalar field model. There is no need to renormalize the bradyon mass even though the dressed bradyon has a tachyon cloud. (auth)

14546 CONFORMAL-INVARIANT GREEN FUNCTIONS WITHOUT ULTRAVIOLET DIVERGENCES. Mack, G.; Todorov, I.T. (International Centre for Theoretical Physics, Miramare-Trieste, Italy). Phys. Rev. D 8: No. 6, 1764-1787 (15 Sept 1973).

It is known that conformal invariance, with anomalous dimensions, determines the 2- and 3-point functions in relativistic quantum field theory up to some constants. It is then natural to use these to construct the skeleton-graph expansion of the general n-point Green function. We demonstrate that this leads to well-defined conformal-invariant expressions, for nonexceptional external momenta, given by ordinary convergent (Riemann) integrals. This also applies to the integrals in the Schwinger–Dyson equation for the 2- and 3-point functions. These results support in particular conjectures recently advanced by Migdal—including self-consistency of conformal invariance. All results are derived for (pseudo-) scalar Yukawa theory. (auth)

14547 CLASS OF FIELDS IN SNYDER SPACES. Hamilton, M.R. (Department of Physics and Astronomy, Hunter College of The City University of New York, New York, New York 10021); Sandri, G. Phys. Rev. D 8: No. 6, 1788-1795 (15 Sept 1973).

A class of fields is constructed explicitly within the models of quantized space-time first proposed by Snyder. These fields contain explicitly the "elementary length" a, in contrast with the fields originally obtained by Snyder, which can be obtained from ours by letting $a \to 0$. We show that the electrostatic energy of an unquantized point charge can be made finite by a suitable choice of the basic commutators even though an elementary volume does not exist in the theory. (auth)

14548 MANIFESTLY COVARIANT AND MANIFESTLY UNITARY FORMULATIONS OF MASSIVE VECTOR-BOSON THEORY IN INDEFINITE-METRIC SPACES. Haller, K. (University of Connecticut, Storrs, Connecticut 06268). Phys. Rev. D 8: No. 6, 1796-1807 (15 Sept 1973).

A theory is formulated in which massive neutral vector bosons are coupled to a conserved current. The scalar bosons are excluded by using a Gupta–Bleuler-type subsidiary condition which requires the use of an indefinite-metric space. There are two different versions of the theory. One version exhibits manifest covariance and simple Feynman rules that are readily renormalized, but is burdened by unitarity problems. The other version is not manifestly covariant, involves reference to special Lorentz frames, and requires nonlocal operators. It is however manifestly unitary and probabilistically interpretable, since the sum of all transition probabilities = 1, and all probabilities are separately positive semidefinite. The two versions are related by a theorem which demonstrates that S-matrix elements are identical in the two versions, except for singular cases such as occur in wave-funciton renormalization terms. This identity also extends to the Proca theory, although, unlike the Proca theory, the theory treated in this work permits vector bosons to be massive, without requiring it; therefore no singularities or consistency problems arise in its $M \to 0$ limit. The allowed nontransverse mode in this theory physically behaves like longitudinally polarized Proca bosons. The gauge invariance of this theory is discussed and compared with the gauge invariance of quantum electrodynamics. (auth)

14549 BOUND-STATE PROBLEM IN A MODEL NONPOLYNOMIAL-LAGRANGIAN THEORY. Biswas, S.N.; Chaudhuri, R.N.; Malik, G.P. (Department of Physics and Astrophysics, University of Delhi, Delhi-7, India). Phys. Rev. D 8: No. 6, 1808-1815 (15 Sept 1973).

We have shown that the bound-state problem in a nonpolynomial-Lagrangian theory can be solved as in the usual polynomial theory assuming that a Wick rotation is admissible. For definiteness we have assumed the interaction of two scalar fields interacting via the exchange of a superfield to be of the form $U(x) = \exp[g\phi(x)]$, where g denotes the minor coupling constant and $\phi(x)$ is a massless neutral scalar field. The major coupling constant is introduced through the ladder diagrams in the Bethe-Salpeter formalism. We find that the Wick-rotated Bethe-Salpeter equation reduces to a

standard Fredholm equation with a modified kernel corresponding to the exchange of the superfield U(x). To study the physical content in the theory we have investigated the equation in the instantaneous approximation. The resulting nonrelativistic equation is projected onto the surface of a four-dimensional sphere by using Fock's transformation variables. The bound-state eigenvalue problem is solved approximately in the weak-binding limit, using Hecke's theorem, leading to a Balmer-type formula. Finally, the fully relativistic equation at E = 0 is considered by transforming it onto the surface of a five-dimensional Euclidean sphere. The approximate-symmetry property of the equation is studied, and the eigenvalue problem is solved in terms of the coupling constants of the theory. (auth)

14550 METHOD OF CHARACTERISTICS AND CAUSALITY OF FIELD PROPAGATION. Mathews, P.M. (Center for Particle Theory, University of Texas, Austin, Texas 78712); Seetharaman, M. Phys. Rev. D 8: No. 6, 1815-1816 (15 Sept 1973).

It is pointed out that the method of characteristics gives only a necessary condition (not a sufficient one) for causality of field propagation. It is shown that the usual theory of vector fields with anomalous magnetic moment coupling to an external magnetic field is noncausal, contrary to what has been believed, as one of its modes of propagation turns out to be tachyonic, with the velocity of light as minimum velocity. (auth)

14551 CANONICAL QUANTIZATION ON THE NULL PLANE. Banyai, L.; Mezincescu, L. (Inst. of Physics, Bucharest). Rev. Roum. Phys.; 18: No. 8, 1035-1049(1973).

Quantization of free fields and spinor electrodynamics on the null plane is performed using Dirac's canonical formalism with constraints. (auth)

14552 SOME GENERALIZATIONS OF FIELD QUANTIZATION AND STATISTICS. Geyer, B. Acta Univ. Wratislaviensis; 1: No. 164, 159-173(1972).

Only the field theoretical aspects of quantization are considered. The general properties of quantizations, quantization of the dimensional systems, field quantization with bilinear Hamiltonians, and uncoupled oscillators are discussed. (JFP)

14553 PRECISE PROCEDURE OF FIELD QUANTIZATION. Rayski, J. Acta Univ. Wratislaviensis; 1: No. 164, 139-149(1972).

The discussion covers the difficulties connected with the infinite volume and with the problem of an axiomatic formulation of the vanishing rest mass case. (JFP)

14554 ASYMPTOTIC CONDITION AND INFRARED DIVERGENCES IN QUANTUM ELECTRODYNAMICS. Faddeev, L. D. (Inst. of Mathematics, Leningrad). Acta Univ. Wratislaviensis; 1: No. 164, 69-78(1972).

A lecture is given on a paper by P Kulish and L. D. Faddeev Theor. Math. Phys. 4, 153 (1970). The motivations and results are briefly described. (JFP)

14555 ULTRALOCAL QUANTUM FIELD THEORY. Klauder, J. R. (Bell Telephone Labs., Inc., Murray Hill, NJ). Acta Univ. Wratislaviensis; 1: No. 164, 1-68(1972).

A special class of model theories, differing from relativistic theories by the absence of the spatial gradient in the Hamiltonian, is discussed. Simple operator solutions are constructed which circumvent the infinite mass renormalization, infinite coupling constant renormalization and infinite field strength renormalization inherent in a perturbation approach. A number of properties of these solutions are analyzed including the spectrum of the Hamiltonian. Compared to free field theories, the ultralocal models discussed herein may, conceivably, provide an alternate starting point to attack covariant field theories. (auth)

14556 RELATIVISTIC MOTION EQUATIONS FOR A SYSTEM WITH VARIABLE SPIN. Nikitin, A. G. (Inst. of Mathematics, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 18: No. 10, 1605-1614(Oct 1973). (In Russian).

Relativistic motion equations are obtained for a quantum-mechanical system which may be in the states with different spin, possible spin values lying in the arbitrary preset interval. The equations obtained are of the Schroedinger form, invariant with respect to the Poincaré full group transformations and do not contain superfluous (nonphysical) components. (auth)

14557 EUCLIDEAN FERMI FIELDS AND A FEYNMAN-KAC FORMULA FOR BOSON-FERMION MODELS. Osterwalder, K.; Schrader, R. (Harvard Univ., Cambridge, MA). Helv. Phys. Acta; 46: No. 3, 277-302(1973).

Free, covariant Euclidean, Bose, and Fermi fields are defined, and their relation with the corresponding relativistic free fields is established. Using this correspondence, a Feynman-Kac formula for boson-fermion models is proved. (auth)

14558 LIE ALGEBRAS CONNECTED WITH INFINITE MOMENTUM KINEMATICS. Biasi, A.; Collina, R. (Istituto di Scienze Fisiche dell'Università-Genova). J. Math. Phys. (N.Y.) 14: No. 11, 1546-1550 (Nov 1973).

In this paper we investigate the Lie algebras obtained from the infinite momentum limit of the Poincaré group. It will be shown that this limit depends upon a real, nonnegative number γ, and so do the structure constants of the resulting Lie algebra, which has three singular points $\gamma = 1, 0, \infty$. The last two singularities give algebras isomorphic to two different contractions of the algebra of the Poincaré group, while the case $\gamma = 1$ gives an algebra which cannot be obtained in this fashion. Suggestions are provided towards a physical interpretation of these results. (auth)

14559 POSITIVITY FOR SOME GENERALIZED YUKAWA MODELS IN ONE SPACE DIMENSION. Federbush, P. (Department of Mathematics, University of Michigan, Ann Arbor, Michigan 48104). J. Math. Phys. (N.Y.) 14: No. 11, 1532-1542 (Nov 1973).

For the model $(g\bar{\psi}\psi\phi^N + \phi^{2M})_{1+1}$ in a box the energy is bounded below if M > N. (auth)

14560 APPROXIMATE RADIATIVE SOLUTIONS OF THE YANG-MILLS FIELD EQUATIONS. Kerner, R. (Univ., Paris). Int. J. Theor. Phys.; 8: No. 4, 263-276(1973).

In this paper the asymptotic radiative solutions of the Yang-Mills field equations are looked for. Considering the potential of the Yang-Mills field as a connection in a principal fibre bundle gives a fully covariant formalism similar to the formalism of the General Relativity. The results obtained by Mme Choquet-Bruhat (Compte rendu hebdomadaire des seances de l'Academie des sciences; 258 (1964)) for the gravitational field are applied directly by means of the W. K. B. method. After deriving the equations for the asymptotic waves and interpreting the zero-order conditions as the initial conditions, some known trivial solutions of the Yang-Mills field equations are considered as the "background field" and the asymptotic waves are constructed explicitly. All the solutions considered turn out to be of the electromagnetic type, with some extra restrictions of the algebraic type. (auth)

14561 CONFORMAL COVARIANT QUANTUM FIELD THEORY. Mack, G. (Univ., Bern). pp 109-130 of Scale and Conformal Symmetry in Hadron Physics. Gatto, R. (Ed.). New York; John Wiley and Sons, Inc. (1973).

From scale and conformal symmetry in hadron physics meeting; Frascati, Italy (4 May 1972). See CONF-7205101-.

A brief survey is given of the progress made in recent years in the understanding of short-distance behavior in quantum field theory. The problem of short-distance behavior within the framework of the Gell-Mann-Low limit theory is reduced to that of studying the properties and possible construction of an exactly conformal invariant quantum field theory. The Migdal-Polyakov bootstrap approach to conformal invariant quantum field theory is briefly reviewed. General developments in the theory are then discussed. (LBS)

14562 CONFORMAL INVARIANCE OF THE COUPLED SPINOR-VECTOR FIELDS. Hamilton, J. D. (Selkirk Coll., Castlegar, B. C.). Can. J. Phys.; 51: No. 3, 316-321(1 Feb 1973).

Conformal invariance of the coupled spinor-vector fields in Minkowski space is reviewed. The conservation laws corresponding to this 15-parameter Lie group are found and shown to be similar to those found by Bessel-Hagen for classical electrodynamics. Gauge invariance is maintained throughout. A brief consideration of the meaning of the conformal transformation is also given. (auth)

14563 CONFORMALLY INVARIANT SPINOR FIELD EQUATIONS. Barut, A. O.; Haugen, R. B. (International Centre for Theoretical Physics, Trieste, Italy). Can. J. Phys.; 51: No. 8, 787-788(15 Apr 1973).

An eight-dimensional spinor equation in the six-dimensional space with a conformally invariant mass does exist, contrary to a recent assertion. (auth)

Gravitation and General Relativity

14564 DYNAMICS OF FLUID SPHERES OF UNIFORM DENSITY. Misra, R.M.; Srivastava, D.C. (Department of Physics, University of Gorakhpur, Gorakhpur, U. P., India). Phys. Rev. D 8: No. 6, 1653-1657 (15 Sept 1973).

The adiabatic collapse of spheres of uniform density made up of perfect fluids either electrically neutral or charged has been studied. A set of field equations equivalent to Einstein's field equations are derived in terms of the energy-momentum tensor. With the help of these equations, the following theorems for perfect fluid spheres have been established: (1) For the gravitational collapse or bounce of a homogeneous sphere of perfect fluid the only motions possible are

shear-free, uniform contraction or expansion. (2) For a charged fluid sphere embedded in empty space the conditions $\rho = \rho(t)$ and $\lambda = \mu$ are inconsistent in the sense that either the solutions are static or matter is uncharged. (auth)

14565 GRAVITATIONAL RED SHIFT–A SIMPLE QUANTUM FIELD-THEORETICAL CONSIDERATION IN A CURVED SPACE. Babiker, M. (International Centre for Theoretical Physics, Trieste, Italy). Phys. Rev. D 8: No. 6, 1658-1662 (15 Sept 1973).

The spectrum of a quantum-mechanical system such as a one-electron atom is modified by the gravitational field of a distant massive body. A simple treatment of the two-body problem in a curved space allows a direct evaluation of the gravitational red shift, obtained otherwise by intuitive arguments. (auth)

14566 MOTION OF PARTICLES IN EINSTEIN'S RELATIVISTIC FIELD THEORY. VIII. DISPLACEMENT FIELD, FUNDAMENTAL FIELD, AND GEODESICS. Johnson, C.R. (Department of Physics and Astronomy, University of Georgia, Athens, Georgia 30601). Phys. Rev. D 8: No. 6, 1645-1651 (15 Sept 1973).

In several earlier papers the author developed an approximation method for finding the Lorentz-covariant equations of structure and motion of interacting particles represented by singularities in Einstein's theory of the nonsymmetric field and in Einstein's theory of the gravitational field. In this paper techniques are presented for finding in these theories the displacement field, the fundamental field, and the equations of geodesics—in terms of a field denoted by $\gamma_{\mu\nu}$—to any order of approximation desired. The techniques are applied, and the displacement field, fundamental field, and the equations of geodesics are found, in terms of $\gamma_{\mu\nu}$, to those orders of approximation needed in future work—the fourth order when dealing with charged particles (and investigating interactions over atomic and molecular distances) and the eighth order when dealing with neutral particles (and investigating higher-order gravitational effects). Certain general properties of the above-mentioned fields and equations are also discussed. (auth)

14567 ROLE OF CONSTRAINING FORCES FOR ULTRARELATIVISTIC PARTICLE MOTION AS A SOURCE OF GRAVITATIONAL RADIATION. Price, R.H.; Sandberg, V.D. (Department of Physics, University of Utah, Salt Lake City, Utah 84112). Phys. Rev. D 8: No. 6, 1640-1644 (15 Sept 1973).

A study is made of gravitational radiation from the constraining forces, idealized as stresses in a thin rod, necessary to hold a particle in an ultrarelativistic circular orbit. Both the particle and the constraining forces generate radiation spectra which fall off in frequency as $\omega^{-(1/3)}$ up to a critical frequency, $\omega_{crit} = 3[1-(v_{particle}/v)^2]^{-(3/2)} \times$ frequency of rotation, but the power generated by the constraining forces is much smaller than that due to the particle's mass. (auth)

14568 UNACCELERATED-RETURNING-TWIN PARADOX IN FLAT SPACE-TIME. Brans, C.H. (Physics Department, Loyola University, New Orleans, Louisiana 70118); Stewart, D.R. Phys. Rev. D 8: No. 6, 1662-1666 (15 Sept 1973).

The twin paradox in a flat space-time which is spatially closed on itself is considered. In such a universe, twin B can move with constant velocity away from twin A and yet return younger than A. This paradox cannot be resolved in the usual way since neither twin is accelerated or locally subject to other than flat Minkowski geometry. Thus there are no obvious kinematic, dynamic, or geometric distinctions between the two and yet one experimentally verifies that moving clocks are slowed while the other does not. A global analysis leads to the conclusion that the description of the topology of this universe has imposed a preferred state of rest so that the principle of special relativity, although locally valid, is not globally applicable. (auth)

14569 EVENT HORIZON OF THE TOMIMATSU–SATO METRICS. Tomimatsu, A. (Hiroshima Univ.); Sato, H. Lett. Nuovo Cim.; 8: No. 12, 740-742(17 Nov 1973).

It is proved that in the Tomimatsu-Sato solution (Phys. Rev. Lett. 29: 1344 (1972) to Einstein's vacuum field equation, the surface $x = 1$ of the odd-δ metrics is an event horizon. It is suggested that the discovery of the T-S metrics with odd δ seems to have revealed a new possible type of black holes, that is, the coexistence of a nonsingular event horizon and naked (ringlike) singularities. (LBS)

14570 COMMENT ON THE EQUIVALENCE OF VARIOUS THEORIES OF GRAVITATION. Harrison, E.R. (Astronomy Centre, University of Sussex, Brighton, Sussex, England). Phys. Rev. D 8: No. 6, 1916-1916 (15 Sept 1973).

We may take the view that either the many scalar-tensor formalisms (of Jordan, Brans and Dicke, Hoyle, etc.), are all new and distinctly different theories of gravitation, or they are implicit within the theory of general relativity and therefore do not qualify as new theories of gravitation. There are cogent and persuasive reasons for adopting the latter view. (auth)

14571 ARE THE EINSTEIN AND BRANS-DICKE THEORIES OF GRAVITATION EQUIVALENT? Schwartz, H.M. (Department of Physics, University of Arkansas, Fayetteville, Arkansas 72701). Phys. Rev. D 8: No. 6, 1915-1915 (15 Sept 1973).

The identification of Einstein's general theory of relativity with the Brans-Dicke gravitational theory implicit in a recent paper by Harrison in this journal is shown to be based on a misunderstanding of Einstein's paper, "Hamilton's Principle and the General Theory of Relativity." (auth)

14572 CAUCHY PROBLEM IN THE SCALAR–TENSOR THEORY OF GRAVITY. Robson, E. H. (Polytechnic, Durham, Eng.). Lett. Nuovo Cim.; 8: No. 13, 818-819(24 Nov 1973).

It is demonstrated that if the junction conditions proposed by Narlai (Prog. Theor. Phys. 47: 832(1972)) in the scalar-tensor theory of gravity are satisfied at a hypersurface S which is not null, then suitable boundary conditions are prescribed for the equations of this theory. (LBS)

14573 COVARIANT THEORY OF GRAVITATION. Rosen, N. (Technion-Israel Inst. of Tech., Haifa). Lett. Nuovo Cim.; 8: No. 15, 889-892(8 Dec 1973).

It is shown that a bimetric theory of gravitation incorporating the covariance and equivalence principles can be set up, which leads to many of the results of the general theory of relativity, but which has a much simpler mathematical structure. The theory under consideration makes use of a Riemannian metric tensor $g_{\mu\nu}$ and an axially flat-space metric tensor $\gamma_{\mu\nu}$. (LBS)

14574 EQUATIONS OF EXTERNAL PROBLEM OF N GRAVITATING BODIES TAKING INTO ACCOUNT THE ARGUMENT DEVIATION IN GENERAL RELATIVITY. Pisarenko, V. G. (Inst. of Mathematics, Kiev). Dopov. Akad. Nauk Ukr. RSR, Ser. A; No. 10, 899-905(1973). (In Russian).

Equations are obtained for the external problem of N gravitating moderate-relativistic bodies with taking into account the delay of interaction forces in general relativity theory. The obtained equations are generalization of the Newton's law of universal gravitation taking into account demands of the relativistic gravitation theory and describe the motion of N bodies in relativistic celestial mechanics. (auth)

14575 OPTICAL INTERPRETATION OF THE SCALARS ASSOCIATED WITH THE KERR AND VAIDYA SOLUTIONS. II. Misra, M. (Gujarat Univ., Ahmedabad, India). Lett. Nuovo Cim.; 8: No. 16, 961-962(15 Dec 1973).

It was previously shown that two scalars b and F, which occur in the derivation of the Kerr and Vaidya solutions, are related to the optical parameters θ and ω. Expressions for F and b are written in a form that shows that b is proportional to ω and F is proportional to the ratio between θ and ω, the proportionality coefficients in each case being conserved functions. (LBS)

14576 QUANTUM GRAVITY AND THE ZERO-SLOPE LIMIT OF THE GENERALIZED VIRASORO MODEL. Yoneya, T. (Hokkaido Univ., Sapporo). Lett. Nuovo Cim.; 8: No. 16, 951-955 (15 Dec 1973).

It is demonstrated that the quantum theory of gravity can be a zero-slope limit of the generalized Virasoro model where the Regge intercept is fixed at two. The quantum theory of gravity is taken to mean Gupta–Feynman's perturbation on the flat background. The correspondence for the graviton Compton scattering is demonstrated by direct calculations. (LBS)

14577 VARIATIONAL PRINCIPLES ASSOCIATED WITH THE GENERAL LINEAR GRAVITY WAVE PROBLEM. Murray, J. C. (Univ. of Southampton, Eng.). Lett. Nuovo Cim.; 8: No. 13, 794-798(24 Nov 1973).

It was previously shown that the transient linear gravity wave problem could be characterized by a variational principle by using the method of time convolutions due to Gurtin. Three further variational principles associated with the general linear gravity wave problem are established. (LBS)

14578 THIN-SANDWICH CONJECTURE AND A FIFTH INITIAL VALUE EQUATION FOR THE GRAVITATIONAL FIELD. Pereira, C.M. (Center for Theoretical Physics, Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). J. Math. Phys. (N.Y.) 14: No. 11, 1498-1501 (Nov 1973).

The thin-sandwich conjecture for Einstein's field equations of general relativity is discussed. Three of the four initial-value equations of general relativity are considered. This system of three equations is shown to have an integrability condition when the spatial metric, its time rate of change, and the lapse function N are given. The nature of this integrability condition is discussed in detail. It is also noted that this integrability condition can be expected to play a significant role in any proof of existence for a thin-sandwich problem in which the spatial metric and its time derivative are chosen arbitrarily. A local proof of existence is given for the first three thin-sandwich equations. The proof allows the spatial metric components, their time rate of change, and the

lapse function N to be chosen arbitrarily. No coordinate conditions of any kind are used in the proof. (auth)

14579 PROJECTIVE MANIFOLDS AND PROJECTIVE THEORY OF RELATIVITY. Evans, G.T.; Sen, D.K. (Department of Mathematics, University of Toronto, Toronto M5S 1A1, Canada). J. Math. Phys. (N.Y.) 14: No. 11, 1668-1674 (Nov 1973).

We present a global formulation of projective theories of relativity in the framework of projective manifolds, that is, manifolds based on the pseudogroup of homogeneous transformations in R^5. Apart from formulating every previously considered geometric object and physical relation in an invariant manner, some new results, such as the theorem on the semidirect product structure of the invariance group of Einstein–Maxwell equations, and theorems on topological restrictions on the underlying five-dimensional projective manifold, etc. have been obtained. The relationship between space-time and the auxiliary 5-manifold is clarified and investigated in detail. A more general geometric definition of the electromagnetic field tensor and a geometric interpretation of the charge/mass ratio is given. (auth)

14580 EXISTENCE AND UNIQUENESS OF SOLUTIONS OF THE HAMILTONIAN CONSTRAINT OF GENERAL RELATIVITY ON COMPACT MANIFOLDS. O'Murchadha, N.; York, J.W. Jr. (Joseph Henry Laboratories, Princeton University, Princeton, New Jersey 08540). J. Math. Phys. (N.Y.) 14: No. 11, 1551-1557 (Nov 1973).

The Hamiltonian constraint "$G^{00} = 8\pi T^{00}$" of general relativity is written as a quasilinear elliptic differential equation for the conformal factor of the metric of a three-dimensional spacelike manifold. It is shown that for "almost every" configuration of initial data on a compact manifold, with or without boundary, a solution exists. Dirichlet boundary conditions are assumed if the boundary is not empty. The solution is unique. (auth)

REACTOR TECHNOLOGY AND REGULATION

14581 (TRG-Inf.Ser.-678(2nd Ed.)) NUCLEAR POWER REACTOR ENGINEERING: SELECTED AND ANNOTATED REFERENCES. Roche, H. A. (comp.). (UKAEA Reactor Group, Risley). Oct 1973. 22p. Dep. NTIS (U.S. Sales Only) $3.25. UK 50 pence.

A selective bibliography is presented consisting of 139 references covering nuclear power reactor engineering at both a basic and an advanced level. It includes English language publications only, and consists almost entirely of books, the exceptions being a few periodicals containing important symposia which were not published elsewhere. The history and theory of the subject are covered, and sections are devoted to publications on the design, construction, and operation of power reactors; nuclear fuels; materials and components used in reactors; and finally, control and safety. As far as possible all types of nuclear fission power reactors have been dealt with. Related aspects of the subject such as reprocessing of fuels, radioactive waste disposal, economics, environmental problems etc. are not included. (auth)

14582 (WASH-1208(12-73)) STATUS OF CENTRAL STATION NUCLEAR POWER REACTORS SIGNIFICANT MILESTONES. (USAEC Division of Reactor Research and Development, Washington, D. C.). 1 Dec 1973. 12p. Dep. NTIS $3.00.

Information on all U. S. central station power reactors including those in operation, shutdown, under construction, and proposed is presented in tabular form. The information includes owner, reactor type, generating capacity, builder, and significant dates. (JWR)

14583 WHITE PAPER ON ATOMIC ENERGY FOR 1973. (Atomic Energy Commission, Tokyo). Genshiryoku Hakusho; No. 17, 1-127(Aug 1973). (In Japanese).

The development and utilization of atomic energy are essential for Japan, as seen in the current state of nuclear power generation and radiation uses. It is also closely related to the enhancement of national livelihood and economic activities. A major issue presently is the safety of nuclear power generation, including its siting. Information on the nation's atomic energy for the year 1973 is subdivided in the following categories: nuclear power generation; security of the safety; environmental conservation; nuclear fuels; enriched uranium; power reactor development; nuclear-powered ships; radiation utilizations; basic research and specific works; atomic energy industry; international cooperation; safeguards; budgets; etc. (JA)

14584 ASSESSING ADVANCED METHODS OF GENERATION. Hauser, L. G. (Westinghouse Electric Corp., Pittsburgh). Arch. Energiewirt.; 27: No. 20, 989-999(1973). (In German).

Following a fundamental introduction, the special points of the following energy sources are described in a general manner: coal gasification, breeder reactor, core melting, solar energy, geothermal energy and fuel cells. (GE)

14585 ITALIAN NUCLEAR RESEARCH AND DEVELOPMENT PROGRAMME COVERING THE PERIOD OF 1973-1977. Clementel, E. (CNEN, Rome). Com. Naz. Energ. Nucl., Notiz.; 19: No. 8-9, 33-36(1973). (In Italian).

The third Italian Nuclear Program is reviewed. (auth)

Power Reactors, Non-Breeding, BWR-Type

Refer also to abstracts 14128, 14728, 14734, 14746, 14749, 14753, 14760, 14802, 14865, 14871, 14874, 14876, 14889, 14894, 14897-14904, 14906, 14915-14918, 14920, 14921, 14924-14936, 14940-14944, 14952-14961, 14975-14981, 14984, 14987, 14988, 14990, 14991, and 14993-14995.

14586 (CEA-R-4527) BEHAVIOR OF LWR RODS IN THE MOLTEN REGIME: SYNTHESIS OF THE "TOF" AND "TAF" TESTS. de Contenson, G.; Vignesoult, N.; Bazin, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France)). Nov 1973. 71p. (In French). Dep. NTIS (U. S. Sales Only) $5.75.

Ordinary LWR reactors were studied. An irradiation program was undertaken in order to determine under what conditions a specific power implying a limited molten zone is compatible with a good in-pile behavior and a reasonable lifetime for the rods. Two types of rod were tested, the sizes of these rods corresponding to the layout of an LWR reactor. TOF: this size of rod is used in pressurized water reactors; tests were effected with short rods (about 400 mm) having a diameter of 10.7 mm filled with pellets (about 0.9 mm diameter, 270 mm stack length) full of UO_2. TAF: this size of rod is used by "General Electric" for their BWR reactors; tests were effected with short rods (about 400 mm) having a diameter of 14.65 mm filled with annular pellets (13 mm external diameter, 3.5 mm internal diameter, 270 mm stack length). The following irradiations were effected: 16 irradiations of TOF and 5 irradiations in EL 3—1 irradiation of CIRTOF in Silos. The experiments enabled the following characteristics to be determined: the behavior of the rods up to high specific burnups, the maximum reached being 55,000 MWj/t of U; the nature of the molten zones in the UO_2 (using micrography, autoradiography, and x-ray microanalysis); and the behavior of fission products. 7 references. (auth)

14587 (DEU-72-6) HIGHLY EFFICIENT SLIDING RING SEALS FOR HYDRAULIC- AND BOILING WATER REACTORS. Mayer, E. (Burgmann (Feodor) Asbest- und Packungswerk, Wolfratshausen (F. R. Germany)). 1971. 7p. (In German). INIS.

Sliding ring seals have been proved in primary pumps and in secondary circuits of light water reactors to be reliable and operationally safe sealing elements. In boiling water reactors, sliding ring seals in triple tandem arrangement have been used for the most part, while in pressurized water reactors it has been usual to employ triple or quadruple combinations. Presently the most reliable seals are thermohydrodynamic sliding ring types which attain unusually high lifetimes. The trend is towards hydrodynamic sliding ring sealing which, as compared to hydrostatic sealing, is also more favorable with respect to leakage and thermal power dissipation. (INIS)

14588 (NEDO-10183) CORE STANDBY COOLING SYSTEMS FOR THE GENERAL ELECTRIC 1969 BWR STANDARD PLANTS. (General Electric Co., San Jose, Calif. (USA). Atomic Power Equipment Dept.). May 1970. 302p.

To serve as an effective basis for review of the 1969 BWR Product Line Core Standby Cooling Systems, descriptive and analytical support information is presented for the CSC systems needed for four particular plant sizes: the small 183" vessel size (500 MW(e)), the intermediate 218" vessel size (800 MW(e)), the large 251" vessel size (1100 MW(e)), and a future potential 269" vessel size (1290 MW(e)). Although a complete project review of the future potential-sized plant has not been made, it is expected that a generic review can be made of the CSC systems for the entire spectrum of plant sizes and future potential sizes. The employment of a more refined heat transfer analytical model, which has been used in all safety evaluations for the last two years, is the major reason for the excellent behavior of this new CSCS. For this reason, considerable emphasis is given to the detailed description of this model. Although not really related to the CSCS concept, analyses, or performance evaluations, the new systems will be built to conform to the applicable current codes and standards. 12 references. (auth)

14589 (RT/ING-(73)11) AMLETO: A PRESSURE DROP COMPUTER CODE FOR LWR FUEL BUNDLES. Marinelli, V.; Pastori, L. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 9 Aug 1973. 42p. Dep. NTIS (U. S. Sales Only) $4.25.

14590 EFFECT OF REDUCED CLEARANCE AND ROD BOW ON CHF IN SIMULATED NUCLEAR REACTOR ROD BUNDLES. Lahey, R. T. Jr.; Polomik, E. E. (General Electric Co., San Jose, CA). (1973). vp.

From international meeting on reactor heat transfer; Karlsruhe, Ger. (9 Oct 1973).

The thermal performance of a typical boiling water nuclear reactor (BWR) rod bundle is governed by system parameters and geometric configurations. In this investigation the effect on thermal performance of various off-design corner rod clearances and bowings was appraised in two separate rod bundles. (GE)

14591 OPERATION EXPERIENCE OF FUKUSHIMA I NUCLEAR POWER STATION. Kawahito, T. (Tokyo Electrical Power Co., Inc.). Genshiryoku Kogyo; 19: No. 1, 20-24(Jan 1973). (In Japanese).

Construction of Fukushima I nuclear power station began in January 1967, and commercial operation began on March 26, 1971. Total generated electric power has reached 4285 GWh, and utilization rate has been 70%. By September 1972, the nuclear power plant had been shut down 2 times for periodic inspections, 3 times for accidents, and 5 times for planned stoppage. The accidents included: trip accident of a recirculating pump, trip accident of power transmission line, and electrical pressure regulator accident. Repair work was required on the mechanical seal of the recirculating pump, leak off system of a turbine bypass

valve, a concentrator for radioactive waste liquid, and compressors for off-gas. Two periodic inspections of the nuclear plant were carried out. In this Fukushima I nuclear plant, a boiling water reactor of 1965 year type is installed, on which in-service inspection cannot be effectively performed. The inspection was performed on the reactor coolant pressure boundaries according to ASME SECTION XI. In July 1972, the hold-up instrumentation with activated carbon was constructed to reduce the quantity of radioactive gases released to less than 1/50 of the previous release. (JA)

14592 WUERGASSEN: NUCLEAR ENERGY DEMAND OF THE FUTURE. Gress, R. Messwerte; No. 12, 36-38(1971). (In German).

A general description is given of the nuclear power station emphasizing the reactor instrumentation. (GF)

14593 NUCLEAR REACTOR COOLANT RECIRCULATION SYSTEM. Townsend, H. E. (to General Electric Co.). Canadian Patent 906,691. 1 Aug 1972.

In a boiling-water reactor, the system for recirculating coolant includes one set of jet pumps driven by constant-speed pumps, and a second set driven by feedwater. The rate of flow is controlled by regulating the split of feedwater between the feedwater-driven jet pumps and the feedwater sparger. (CA)

14594 PERMISSIBILITY OF BOILING IN THE DOWNSTREAM END OF A REACTOR IN DYNAMIC REGIMES. Bondarenko, A. V.; Minashin, M. E. At. Energ. (USSR); 35: No. 3, 198-200(Sep 1973). (In Russian).

Laboratory experiments indicated that, to maintain normal circulation and prevent hazards due to interruption of steam movement, the water flow rate at the entrance to the lower section where boiling is possible should not decrease to values close to the slippage factor. (TTT)

14595 EFFECTS OF SITING AND LOAD VARIATION FOR A 650-MW NUCLEAR STATION WITH AIR CONDENSER. Potter, J. H. (Stevens Inst. of Tech., Hoboken, NJ). Combustion; 45: No. 6, 17-20(Dec 1973).

Performance comparisons are offered for water-cooled and air-cooled condensers applied to a 650 MW nuclear steam station. For identical annual power production the cycles are compared when sited at locations with appreciably different climatic conditions. (5 references) (auth)

Power Reactors, Non-Breeding, PWR-Type

Refer also to abstracts 14586, 14587, 14589, 14728–14732, 14749, 14750, 14760, 14870, 14889, 14895, 14896, 14905, 14907–14914, 14919, 14922, 14923, 14936–14939, 14946–14951, 14962–14974, 14982, 14983, 14985, 14986, 14989, 14992, and 14996–15002.

14596 (BAW-10043(Supp.1)) OVERPRESSURE PROTECTION FOR BABCOCK AND WILCOX PRESSURIZED WATER REACTORS WITH 205 FUEL ASSEMBLIES. Carlton, J. D. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). Dec 1973.

Information on the degree of overpressure protection in Babcock & Wilcox pressurized water reactor nuclear steam systems containing 205 fuel assemblies rated up to 3780 MW(t) is presented. The reactor protection system, the pressurizer safety valves, and the steam system safety valves provide overpressure protection for the most severe transients, which include accidental control rod withdrawal from a subcritical condition, turbine trip from an overpower condition, and complete loss of main feedwater from full power. (auth)

14597 (DLCS-5000373) QUARTERLY OPERATING REPORT, THIRD QUARTER 1973. (Duquesne Light Co., Shippingport, Pa. (USA)). 1973. Contract AT(11-1)-292. 19p. Dep. NTIS $3.00.

Activities at the Shippingport Atomic Power Station during the third quarter of 1973 are summarized. The activities are described under the following headings: operations; station performance; chemistry; maintenance; and test program. (JWR)

14598 (GKSS-73-E-11) DRUCK: A PROGRAM FOR COMPUTING THE DYNAMIC BEHAVIOR OF REACTORS OF THE FDR TYPE. Fiebig, R. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Hamburg (West Germany)). 1973. 43p. (In German). Dep. NTIS (U. S. Sales Only) $4.25.

The DRUCK program calculates the dynamic behavior of reactors of the FDR type with the aid of a model for channels connected in series. Processes, such as blow-off of the pressure vessel and pressure changes between 200 and 2 atm, can be calculated. The reactivity reaction of the core given as a point model is described with quasistationary formulas which are valid through suitable interpolation formulas over a wide range. (JSR)

14599 (RT/FI-(73)23) ASSESSMENT OF THE RELIABILITY OF THE CNEN's METHODS FOR THE NEUTRONIC DESIGN OF PWR's. Part III. Analysis of Several Westinghouse Experiments. Gaafer, M.; Orestano, F.; Pistella, F. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 16 Jul 1973. 47p. Dep. NTIS (U.S. Sales Only) $4.50.

The comparison is presented between calculated and measured results for the experiments performed at the Westinghouse Reactor Evaluation Center by Westinghouse in PWR's lattices, with boron and Ag–In–Cd alloy absorbers. The WREC experiments were performed also in the presence of plutonium bearing fuel both in distributed and cluster geometry, with different radius absorbing rods, for different moderating ratio and enrichment of the fuel. The calculational model adopted in the CNEN design codes for a proper treatment of the Ag–In–Cd alloy control cells is also briefly reported. 29 references. (auth)

14600 (WCAP-7765-AR) WESTINGHOUSE PWR INTERNALS VIBRATION SUMMARY. 3-Loop Internals Assurance. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Nov 1973. 67p.

The bases used to formulate the instrumentation program for monitoring vibrations in reactor internals in Westinghouse 3-loop plants are described. The analytical, test, and operational information used in the formulations is discussed. A considerable amount of proprietary data has been deleted. (JWR)

14601 (WCAP-7977) IODINE REMOVAL BY SPRAY IN THE DIABLO CANYON STATION CONTAINMENT. Kemper, R. M. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Nov 1972. 79p.

A comprehensive mathematical model is developed to describe the absorption of elemental iodine vapor from the containment atmosphere by the containment spray system. Specifically, this model includes the effects of drop size by considering the complete spectrum of drop sizes emitted by the containment spray nozzles, condensation of steam on the spray drops, coalescence of drops, and the mass transfer resistance in the liquid phase of the drops. The model is shown to be conservative by theoretical considerations in the derivation, by comparison with alternate models, and by comparison with experimental data. The model is then applied to the Diablo Canyon Station containment. Minimum performance values are used for all parameters which enter the analysis. This evaluation of the iodine removal effectiveness of the containment spray system gives an exponential removal coefficient, λ_s, of 36/hr. Although this value represents a conservative evaluation of the spray system under the most adverse conditions, a design value of λ_s = 31/hr is established by adding additional safety margins to the input parameters. 48 references. (auth)

14602 PROBLEMS OF DESIGN MANAGEMENT IN POWER PLANT ERECTION: ILLUSTRATED BY THE CONCEPT OF STEAM GENERATORS IN PRESSURIZED WATER REACTOR NUCLEAR POWER PLANTS. Altmann, W.; Sauermann, F.; Zschernig, J. (Technische Univ., Dresden). Kernenergie; 16: No. 5, 148-155(May 1973). (In German).

Steam generators for nuclear power plants intended to realize a limit level of utilization by exploring all technological and economical possibilities give a striking example for the necessity of developing an integrating management of design in the concepts of plants and plant elements for energy conversion technique. Their thermodynamical integration into the power plant process, complex interlacing with other plant elements, problems of manufacture, erection and, last but not least, avoidance of failure sources are of such a complexity that optimum solutions depend on both the organization and communication of the working groups involved and the management of technological and economic relationships. (18 references) (auth)

14603 VERTICAL OR HORIZONTAL STEAM GENERATORS IN NUCLEAR POWER PLANTS WITH PRESSURIZED WATER REACTORS. Sauermann, F. (Technische Univ., Dresden). Kernenergie; 16: No. 5, 155-158(May 1973). (In German).

Based on some characteristics and further reflections the advantages and drawbacks of the two main versions of steam generators used in pressurized water reactor nuclear power plants are discussed. (9 references) (auth)

14604 ANALOG COMPUTER DIFFUSION MODEL TO STUDY TIME DEPENDENT PROBLEMS OF POWER DENSITY DISTRIBUTION IN LARGE PRESSURIZED WATER REACTORS. Bock, H. W. Brunswick; Technische Univ. (1972). · 96p. (In German).

Thesis.

To investigate and optimize the program for moving control

rods in pressurized water power reactors, an analog computer diffusion model (ANDI) was developed, in which the reactor core is subdivided into 80 parts. In each part, all events having influence on the power distribution are simulated. In this way ANDI is able to analyze a 15-month fuel element cycle within 30 min. As an example of a technical solution, the control rod system of the STADE REACTOR was studied. (GE)

14605 MEASUREMENT OF LIVE STEAM MOISTURE CONTENT USING THE THROTTLING METHOD. Ruetz, J. (VEB Kernkraftwerke Greifswald, Rheinsberg, Ger.). Kernenergie; 16: No. 1, 13-19(Jan 1973).

GE.

A continuous direct-reading steam moisture gauge operating on the basis of throttling method is described. Effects which have to be taken into consideration during indispensable sampling are elucidated. Preliminary results of measurements obtained in the Rheinsberg nuclear power plant live steam line are discussed. Considerations of accuracy show that by use of this gauge low moisture contents may be measured with sufficiently low tolerance. (auth)

14606 GAMMA-SPECTROMETRIC MEASUREMENTS OF IRRADIATED FUEL ASSEMBLIES OF THE RHEINSBERG NUCLEAR POWER PLANT. Graber, H.; Hofmann, G.; Kaestner, R.; Nagel, S. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Kernenergie; 16: No. 1, 9-13(Jan 1973).

GE.

An experimental arrangement was developed to examine irradiated fuel assemblies and rods of the Rheinsberg WWER-2 reactor by gamma spectrometry. The equipment operating in the reactor hall consists of a shielding container, a collimator system, a transport and scanning machine, and a Ge(Li) spectrometer. The general arrangement of the measuring apparatus is described. Preliminary results of measurements of an irradiated first charge fuel assembly are given. The influence of both the distance grids and the fuel rod arrangement inside the assembly on the gamma intensity measured are shown. The relative distribution of some long-lived fission products along the assembly was determined. (auth)

14607 DEVICE FOR AUTOMATICALLY SWITCHING A FEED FLOW FROM ONE TO THE OTHER OF TWO PARALLEL BRANCH LINES OF AN EMERGENCY COOLING SYSTEM, ESPECIALLY IN NUCLEAR REACTORS. Fruth, H. (to Siemens Aktiegesellschaft). US Patent 3,779,266. 18 Dec 1973. Priority Date 24 Dec 1970, F. R. Germany. 6p.

A device is described for automatically switching a feed flow from one to the other of two parallel lines branching from a feed line when a break occurs in one of the branch lines. The device includes a piston-controlled three-way valve situated at a location of the feed line at which the branch lines branch off, the three-way valve having an inlet connected to the feed line and a respective outlet connected to each of the branch lines. The three-way valve has a valve member normally closing one of the outlets and is operatively connected to a displaceable piston and actuable thereby for opening the normally closed outlet and closing the other of the outlets. A fixed throttle is disposed in each of the outlets. (Official Gazette)

14608 PRESSURIZED FUEL ELEMENTS FOR A NUCLEAR REACTOR. Bratton, R. J.; Roberts, E.; Smerd, P. G. (to Westinghouse Electric Corp.). US Patent 3,772,147. 13 Nov 1973. Filed Date 27 Oct 1970. 6p.

An internally pressurized hermetically clad fuel element for a nuclear reactor is described having a normally sealed chamber within the fuel element plenum is described. The chamber is maintained at a lower pressure than the internal pressure of the fuel element and at least a portion of one of the chamber walls is formed from a permeable membrane material which allows the plenum gases to diffuse into the chamber at a rate comparable to the rate of fission gas release from the fuel during burnup. (Official Gazette)

14609 FUEL ASSEMBLY HOLD-DOWN DEVICE. Klumb, R. H.; Hutchinson, J. J. (to Combustion Engineering, Inc.). US Patent 3,770,583. 6 Nov 1973. Filed Date 20 May 1971. 10p.

The invention provides a hold-down device which maintains a net downward force on a fuel assembly in a nuclear reactor under all thermal and hydraulic conditions in the reactor core region. The hold-down device is particularly applicable in reactors having stainless steel support barrels and Zircaloy guide tubes. The hold-down device of the preferred embodiment of the invention is comprised of coil springs coaxially disposed about alignment posts which extend upwardly from the top end plate of each fuel assembly. A hold-down plate is slideably mounted on the alignment posts and the coil springs are interposed, in compression, between the hold-down plate and the top end plate. In use, the coil springs bias the hold-down plate upwardly against a core alignment plate to provide a downward force on the fuel assembly. The hold-down plate may also serve as a lifting surface for the fuel assembly during fuel handling. (Official Gazette)

Power Reactors, Non-Breeding, Graphite Moderated

Refer also to abstracts 13093, 14654, 14675, 14757, 14802, 14845, 14846, 14857, and 14945.

14610 (CONF-731203-2) ENVIRONMENTAL AND ECONOMIC FACTORS ASSOCIATED WITH HIGH-TEMPERATURE GAS-COOLED REACTORS. Kasten, P. R. (Oak Ridge National Lab., Tenn. (USA)). 1973. 18p. Dep. NTIS $3.00.

From conference on decision and control; San Diego, California, USA (5 Dec 1973).

Design characteristics of HTGR type power reactors are presented. Economic aspects of HTGR operations are described. The radioactive effluents from HTGR power plants and fuel reprocessing plants are discussed. (DCC)

14611 (GULF-GA-A-12764) PSC STEAM GENERATOR HOT FLOW TEST. Kaufman, J. S. (Gulf General Atomic Co., San Diego, Calif. (USA)). 19 Sep 1973. Contract AT(04-3)-633. 19p. Dep. NTIS $4.00.

The PSC Steam Generator Hot Flow Test was a vibration test of one steam generator module installed in the PCRV. Module number 7, at PCRV location B-1-6, was instrumented with strain gages during fabrication of the steam generator. The test was conducted by flowing helium heated by compression of circulators in loop number 1 through the test module at velocities exceeding the maximum inlet velocity corresponding to 100% steam flow. The tests were started in June 1972, however due to plant operating problems, the tests were discontinued and the entire test was completed during July 1973. The 1972 tests provided an opportunity to survey the steam generator vibrations and based on this survey the grouping of strain gage leads to the switches was changed to allow for more rapid data taking. Results of the tests showed all measured vibration levels to be well within acceptable limits. 12 references. (auth)

14612 (INIS-mf-924) CORE OPTIMIZATION OF A 600 MW(e) HTGR REACTOR. Dieguez, J. A. D. (Sao Paulo Univ. (Brazil). Escola Politecnica). 1970. 59p. (In Portuguese). INIS.

Thesis.

A complete thermal analysis of a HTGR is made based on a "Backup Design". Parameters such as: maximum temperature, minimum number of channels and inlet temperature limits are mainly considered. The "Backup Design" is based on the Fort St. Vrain power station reactor type of 600 MW(e). (auth)

14613 TIMING THE UTILIZATION OF RECYCLE FUELS IN HIGH-TEMPERATURE GAS-COOLED REACTORS. Homan, F. J. (Oak Ridge National Lab., TN). Nucl. Technol.; 21: No. 1, 5-15(Jan 1974).

Calculations to determine the influence of different schemes for the utilization of recycle fuel on High-Temperature Gas-Cooled Reactor (HTGR) fuel cycle costs showed that commercial reprocessing of spent fuel should begin in 1984 or 1985 for the reactor construction schedules assumed. A benefit-to-cost ratio for recycle research and development work was computed and ranges from ~10 to 70, depending on the penetration of the HTGR into the U. S. power generation economy. The presently planned introduction of commercial reprocessing capability in 1985 will result in nearly optimum fuel cycle costs. However, substantial delays beyond this data will result in sizable cost penalties, with the magnitude of the penalties increasing with increasing HTGR market penetration. 14 references. (auth)

14614 CLOSED CYCLE GAS TURBINE PLANT CONTROL SYSTEM: LOAD FOLLOWING FOR GAS TURBINE OPERATING WITH GAS COOLED REACTOR ON A CLOSED CYCLE. Preinreich, G.F.J. (to Dragon). British Patent 60,144/71. 23 Dec 1971.

Available from the Commission of European Communities, Luxembourg.

A closed cycle gas turbine power plant is described which consists of a gas compressor means, a heat source, gas turbine means, a recuperator and a heat rejection gas cooler, a high pressure flowpath for gas serially interconnecting the compressor means outlet, the heat receiving side of the recupera-

tor, the heat source and the gas turbine means inlet, a low pressure flowpath for gas serially interconnecting the gas turbine means outlet, the heat yielding side of the recuperator, and the gas cooler and the compressor means inlet. The high pressure side of the flowpath has two bypass ducts each arranged to bypass a controlled fraction of the total gas flow around one or more components in the flowpath with the effect of lowering the gas temperature at the heat source inlet and at the gas turbine means inlet. (UK)

14615 DIRECTLY COOLED TUBULAR FUEL ELEMENT FOR NUCLEAR REACTORS. De Bacci, M.; Acciarri, P. (to Dragon). British Patent 7507/71. 22 Mar 1971.

Available from the Commission of European Communities, Luxembourg.

The fuel elements relating to gas-cooled reactors and suitable for operation with a thermal reactor as well as a fast reactor are described. It comprises a tubular member composed of a number of annular discs having a central hole and arranged in superposition. Each disc is composed of a double layer of fission product retaining fuel particles embedded in a matrix of graphite or other material so that both layers of particles are virtually directly cooled. Coolant may sweep between the faces of adjacent discs. (UK)

14616 HIGH TEMPERATURE HELIUM TURBINE TEST PLANT IN JUELICH. Energ. Tech.; 25: No. 9, 243-245(1973). (In German).

The current status of the HHT project is described. The HHV plant will begin its trial operation at the end of 1975. (GE)

14617 OPERATING EXPERIENCE WITH THE VARIOUS COMPONENTS OF THE NUCLEAR POWER PLANT BELOYARSK. Nevskij, V. P.; Sasarin, G. A.; Prusinskij, B. J. Arch. Energiewirt.; 27: No. 18, 883-893(1973). (In German).

The experiences obtained during years of operation of both blocks of the nuclear power plant (KKW) are reported. The KKW operates with superheated steam and is a channel reactor (superheat fuel elements in reactor channels). The design of the channels, reactor plant, and the turbine plant is described. Furthermore, the technical and economic data of the plant during operation from 1967 to 1971 are presented. (GE)

14618 SOME ADVANTAGES OF GAS MIXTURES AS WORKING MEDIA FOR NUCLEAR POWER STATIONS WITH FAST-NEUTRON REACTORS. Tetel'baum, S. D.; Klok, A. M.; Gribovskii, V. P.; Kozhelupenko, Yu. D. (Odessa Technological Inst.). Therm. Eng. (USSR) (Engl. Transl.); 19: No. 10, 127-129(Oct 1973).

Translated from Teploenergetika; 19: No. 10, 86-87(1972).

14619 NUCLEAR POWER STATION. Profos, O. (to Sulzer Brothers, Ltd.). US Patent 3,778,346. 11 Dec 1973. Priority Date 29 Sep 1967, Switzerland. 4p.

The nuclear power station is constructed to house the reactor pressure vessel above the machine room ceiling with the ceiling being of a thin thickness. Should a leak of working medium occur in the machine room, the pressure on the ceiling of the machine room is counterbalanced by the weight of the reactor. (Official Gazette)

14620 HIGH TEMPERATURE NUCLEAR REACTORS. Lockett, G. E.; Hosegood, S. B. (to United Kingdom Atomic Energy Authority). US Patent 3,776,814. 4 Dec 1973. Priority Date 2 Mar 1970, United Kingdom of Great Britain and Northern Ireland. 4p.

The difficulties which arise, in conducting heat away from the thermal shield, which lies between a nuclear reactor core and the concrete pressure vessel which contains it, are acute, especially in respect of the underside of the core, and in cases where the direction of coolant flow is vertically downwards. According to the present invention this difficulty is overcome by using thermal conduction to lead away heat from the thermal shield to the concrete vessel in which the usual liquid coolant pipes are embedded. Special measures are taken to ensure a good conductive flow-path which are effective enough to obviate the need of special bleed coolant flows. (Official Gazette)

Power Reactors, Non-Breeding, Otherwise Moderated

Refer also to abstracts 14738 and 14848.

14621 (BARC/I-176, pp 157-162) STABILITY PROBLEMS OF A CANDU-BLW REACTOR. Purandare, H. D. (Bhabha Atomic Research Centre, Bombay). 1972.

Problems concerning the stability of the CANDU reactor when light water is introduced as the coolant are analyzed. The difficulties arising out of void formation, spatial stability and coupling in a reactor are discussed and the effects of feedback in a BLW reactor are mentioned. The decoupling in a reactor is described in detail. The relation between neutron and hydrodynamic coupling and the methods of investigation of stability and effective control are outlined briefly. (INIS)

14622 (BARC/I-190, pp 38-59) MULTIGROUP CODES FOR HEAVY WATER LATTICE CALCULATIONS. Huria, H. C.; Jain, V. K.; Srinivasan, K. R.; Srivenkatesan, R. (Bhabha Atomic Research Centre, Bombay). 1972.

Two codes EPITHERM and SUCCESSOR, for the calculation of lattice parameters of heavy water moderated lattices, are described. Both the codes use multigroup multiregion collision probability techniques to obtain lattice parameters for a cylindrical cell. Further improvements to be incorporated in the future in the above codes are mentioned. The methods used to obtain group cross sections for ^{235}U and ^{238}U etc. are included. (INIS)

14623 (BARC/I-190, pp 60-77) FEW GROUP METHODS IN REACTOR DESIGN CALCULATIONS. Balakrishnan, K. (Bhabha Atomic Research Centre, Bombay). 1972.

Few group calculations are found to yield results which are nearly as accurate as the more time consuming multigroup methods. The theory of a typical few group lattice calculational method (METHUSELAH CODE) is described in detail. The calculations are done only for a cylindrical geometry. The neutrons in a heavy water reactor are treated in five energy groups consisting of three fast groups and two overlapping thermal groups. The method of calculating the fuel composition at any irradiation is explained in the case of a few elements, such as ^{236}U, ^{239}Np, etc. (INIS)

14624 (BARC/I-190, pp 135-195) PHYSICS OF RAPP REACTOR. Nakra, A. N. (Bhabha Atomic Research Centre, Bombay). 1972.

The work done on the physics calculations for the Rajasthan reactor, India, is summarized. The results of the present study are compared with the Canadian results and also with those obtained in the Douglas Point Reactor. A satisfactory agreement is observed between the results obtained here and those predicted by Canadians. A brief outline of the computer codes used for these calculations is also given. Detailed diagrams and tables relating to the design parameters of the reactor are included. (INIS)

14625 (INIS-mf-87) EXPERIMENTAL APPLICATION OF THE A-1 POWER STATION. Spetko, V. (Atomova Elektraren, Jaslovske Bohunice (Czechoslovakia)). [nd]. 12p. (In Slovak). (CONF-701214-4). INIS.

From fifth conference on nuclear power; Piestany, Czechoslovakia (1 Dec 1970).

The following components of the A-1 power station are considered to be suited for experimental applications: the primary circuit with steam generators and turbo-compressors, the system of dosimetric control, the ventilation system, and the system for dosimetric measurements in the environment of the power station. A description is given of the problems which operation of the power station will solve, i.e. problems of materials research, physics and heat engineering of nuclear reactors, operating conditions of nuclear power stations, etc. (INIS)

14626 (INIS-mf-866) RADIATION SHIELDING FOR MODIFIED 200 MW(e) REACTOR (NARORA). Behari, L. V.; Chamany, B. F. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 9p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

For ease of fabrication and transportation of shop assembled components, especially massive end-shields, a new concept was evolved where the reactor vessel is suspended in a water filled vault and the end shields are fabricated vessels filled with steel-balls and water. The shield effectiveness of these configurations is calculated and compared with that of the earlier concept of iron-water slabs. The adequacy of the new concept has been established, and the results presented. (INIS)

14627 (SLA-73-694) DEVELOPMENT OF THE NEUTRON POWER MONITOR FOR THE NUCLEAR POWER DEMONSTRATION REACTOR. Campbell, J. W.; Todd, J. L. (Sandia Labs., Albuquerque, N.Mex. (USA)). Dec 1973. Contract AT(29-1)-789. 87p. Dep. NTIS $6.50.

The development of the neutron power monitor (NPM) installed at the nuclear power demonstration (NPD) reactor in Ontario, Canada, as a part of the Safeguard Surveillance system is de-

scribed. One sensor of the system provides a semiquantitative record of the NPD reactor power to give a Safeguard inspector an approximation to the power history of the reactor. These data are used for estimating the amount of fissile material consumed. The estimate is then used to determine whether fuel "burn-up" is within normal limits. The reactor parameter selected for measurement as an indication of reactor operating power was the neutron flux at a fixed point near the reactor. Although a single-point measurement of this type is not a precise indication of reactor power, it should be fairly representative under normal conditions. (8 references) (auth)

14628 (ZJE-128) REMOTE CORROSION MEASUREMENTS CARRIED OUT DURING COMPLEX TESTS OF THE A-1 REACTOR. Beran, J.; Pipka, J.; Sulc, J.; Cerny, K. (Skoda, Plzen (Czechoslovakia). Zavod Vystavba Jadernych Elektraren). 1972. 12p. INIS.

As a basis for the corrosion measurement in the A-1 reactor, corrosion probes were used placed in the piping of heavy-water circuit outside of the reactor. Each probe was used for two types of measurement: the instantaneous corrosion rate and the instantaneous corrosion attack measurements. For the measurement of the instantaneous corrosion rate a method is used of the polarization resistance according to Stern and Geary. The determination of the corrosion attack is carried out using the current transients observed in the element consisting of two electrodes, both from the same metal. Corrosion environment was measured consisting of heavy water, saturated with carbon dioxide at a temperature of 90°C and a pressure of 65 at. It circulates in the primary circuit at a velocity of up to 3 m/sec; water temperature varies between 40°C and 90°C. (auth)

14629 RESONANCE INTEGRALS AND CORRECTIONS OF FLAT FLUX FOR CLUSTER FUEL ELEMENTS. Stech, S.; Lehmann, M. (Skoda Works, Plzen, Czech.). Kernenergie; 16: No. 5, 137-143(May 1973).

An investigation was conducted to estimate the error when a flat-flux approximation is used to compute the resolved resonance integrals for the cluster-type fuel element embedded in a heavy-water moderator. A more accurate way according to the heterogeneous structure of the cluster as well as to the first collision probability in the different regions of the reactor cell has been used. The spatial dependence of resonance reaction density has been approximated by a linear function. From the solution obtained by the above method the error ascribable to the flat-flux approximation has been found to be small for the given cluster-type fuel element. (8 references) (auth)

14630 HEAVY WATER NUCLEAR REACTOR. Steinert, C.; Schlosser, G. (to Siemens AG). German Patent 1,564,760. 5 Mar 1970. Filed date 16 Nov 1966. (In German).

The core of the reactor is identical with that of a light water reactor and is made up of fuel rods separated at a distance of the order of magnitude of their diameter. The fuel is in a dilute form, for example, only in the region of the mantle and not in the central region of the core. (TSS)

14631 REACTOR DEVELOPMENT (PHW, ABLW, OCR). Mooradian, A. J. (Atomic Energy of Canada Ltd., Chalk River, Ont.). pp vp of Proceedings of the 1972 Annual Conference of the Canadian Nuclear Association. Chalk River, Ont.; Atomic Energy of Canada Ltd. (1972).

From Canadian Nuclear Association 1972 annual conference; Ottawa, Ontario (11 Jun 1972). Paper No. 72-CNA-401.

The Canadian power reactor programme was planned in the expectation that the Pickering reactors would be a success, so their success need not prevent further development of the boiling light water (BLW) (Gentilly) and organic-cooled (WR-1) variants of the CANDU system. By 1980 Canadian spent fuel will probably contain 7600 kg of plutonium, and probably the rate of production will be 1600 kg per year then. Probably, this plutonium could best be used in a CANDU-BLW reactor. Whereas Gentilly has proven that natural-uranium cores can be operated stably at 250 MW(e) and possibly up to 500 MW(e), cores containing plutonium can probably be designed to operate stably at much larger sizes. The organic cooled reactor (OCR) offers two advantages, higher steam temperatures and lower radiation fields. At present the coolant outlet temperature in WR-1 reactor is above 400°C. An engineering and cost study of a 500 MW(e) natural-uranium-carbide-fuelled OCR prototype power station has given favorable results. Present technology will give a practical net station efficiency of 35 to 36%, and 40% may not be impossible with future technology. Development work on the pressurized-heavy-water (PHW) system has included development on an improved zirconium-clad uranium oxide fuel known as CANLUB. U_3Si fuel is being studied. PHW reactors as large as 1200 MW(e) are on the drawing boards. Work at Douglas Point on the problem of activated corrosion products has already reduced the radiation fields in the boiler rooms by a factor of seven. (CA)

14632 EARLY OPERATING PERFORMANCE AT PICKERING GENERATING STATION. Horton, E. P. (Hydro-Electric Power Commission of Ontario, Pickering). pp vp of Proceedings of the 1972 Annual Conference of the Canadian Nuclear Association. Chalk River, Ont.; Atomic Energy of Canada Ltd. (1972).

From Canadian Nuclear Association 1972 annual conference; Ottawa, Ontario (11 Jun 1972). Paper No. 72-CNA-302.

Two units of the four-unit Pickering generating station are now in commercial service and each has been providing a reliable source of 512 MWe net to the Ontario Hydro grid. The third unit is in the final stages of commissioning and Unit 4 is expected to be available on schedule in early 1973. There have been the usual hundreds of problems and deficiencies, but these have been corrected as required and commissioning work to date has not revealed any problems that resulted in major delays. Unit 1 proceeded from first critical to full power in 13 weeks and was declared in-service in an additional 9 weeks. On Unit 2 these times were reduced to 8 weeks and 7 weeks. On-power refuelling was available for Unit 1 when first required in November 1971 and fuel is being routinely changed on-power. Unit reliability has been better than predicted for early operation, as the net capacity factor for both units has averaged approximately 80% since full power was first achieved. Heavy-water upkeep has also been better than target values and is now well below 1 kg/h for each unit. (auth)

14633 OPERATING EXPERIENCE AT DOUGLAS POINT GS. Armstrong, J. H. (Hydro-Electric Power Commission of Ontario, Tiverton). pp vp of Proceedings of the 1972 Annual Conference of the Canadian Nuclear Association. Chalk River, Ont.; Atomic Energy of Canada Ltd. (1972).

From Canadian Nuclear Association 1972 annual conference; Ottawa, Ontario (11 Jun 1972). Paper No. 72-CNA-301.

Douglas Point is Canada's prototype nuclear-electric station, with a design net output of 208 MWe. The reactor went critical on November 15, 1966. Electricity was produced for the first time on January 7, 1967, and by January 13, power output had reached 110 MWe. Unfortunately, operation during the remainder of 1967 was limited by long shutdowns to replace a damaged calandria tube and to rebuild the heat transport main pumps. The unit was returned to service December 15, 1967. During 1968, the unit was brought to full load in August, declared in-service in September, and achieved a net capacity factor of 43%. In the spring of 1969, the unit was shut down for the turbine-generator warranty inspection and turbine blading failures were discovered. The faulty blades were removed, reducing the unit maximum output to 192 MWe net. On-power fuelling was achieved on March 1, 1970, and has been successful, although it required a major maintenance effort. Unit reliability has steadily improved since 1968, but remains below maturity targets. However, the availability and net capacity factor during the 1971 winter peak months were 88% and 79% respectively. Heavy-water upkeep costs have been several times higher than desired; a significant improvement is expected after the 1972 planned shutdown. Radiation fields have been high, leading to high maintenance radiation doses; however, major decontamination is now being carried out, using very simple methods. We conclude that Douglas Point will continue to contribute invaluable information, and that with dedicated effort it will approach its performance targets. (CA)

14634 EVOLUTION OF CANADIAN NUCLEAR POWER STATION DESIGN. Laurence, G. C. pp vp of Proceedings of the 1972 Annual Conference of the Canadian Nuclear Association. Chalk River, Ont.; Atomic Energy of Canada Ltd. (1972).

From Canadian Nuclear Association 1972 annual conference; Ottawa, Ontario (11 Jun 1972). Paper No. 72-CNA-501.

The development of nuclear power reactors and stations in Canada, from the first laboratory in 1943, is traced. The evolution of the CANDU (Canadian deuterium oxide natural uranium) concept is explained. At present, the main branch of development is the pressurized heavy water reactor, and ways are explained in which this concept evolved from the original NRX and ZEEP reactors, through NPD, Douglas Point, and Pickering generating stations, to the future Bruce Generating Station. For example, reasons are given for the decisions to use uranium oxide fuel, and to have pressure tubes rather than a pressurized reactor. The possible modification of the CANDU concept by using terphenyls as coolant, as in WR1 Research Reactor represents one offshoot from the main branch of CANDU, and another is the boiling light water cooled prototype at Gentilly; these offshoots are explained. Diagrams and photographs illustrate explanations of fuel bundles, control systems (especially moderator dump systems), containment systems and the arrangements of pressure tubes and end-fittings that permit refuelling at power. (CA)

14635 AECL IN THE WORLD MARKET. Leaist, G. T. (Atomic Energy of Canada Ltd., Ottawa). pp vp of Proceedings of the 1972 Annual Conference of the Canadian Nuclear Association. Chalk River, Ont.; Atomic Energy of Canada Ltd. (1972).

From Canadian Nuclear Association 1972 Annual Conference; Ottawa, Ontario (11 Jun 1972). Paper No. 72-CNA-404.

The paper reviews AECL nuclear power marketing experience since it was last reported on at the 1970 Annual Conference of the Canadian Nuclear Association. Some projections are made about future activities. The favorable performance of the Pickering station units, especially in the areas of plant availability, fuelling machine commissioning and operation, and heavy-water conservation, has confirmed the performance claims made for CANDU-PHW system. Now that these claims are being substantiated, the international market is reassessing the Canadian system with renewed interest. (auth)

14636 CONTAINMENT FOR NUCLEAR REACTORS. Ebeling, D. R.; Jones, D. H.; Johnson, F. G. (to United Kingdom Atomic Energy Authority). Canadian Patent 908,320. 22 Aug 1972. Priority date 19 Feb 1969, United Kingdom of Great Britain and Northern Ireland.

Containment systems for water-cooled pressure-tube reactors having a refuelling pond above the reactor are described. Such reactors normally carry the pond on a sturdy grid structure, capable of resisting high loads. However, with sturdy grid structures replacement of pressure tubes is difficult, slow, and expensive. The containment structure is divided by a barrier into a lower chamber housing the reactor and an upper chamber housing the refuelling pond. The barrier provides biological shielding and includes a membrane forming the bottom of the pond structure and which is removable to give access to the top of the reactor. In the event of accident, pressure in the lower chamber is relieved into the upper chamber to prevent overpressurization of the reactor containment; the pond bottom is not subject to high stress and can therefore be of relatively light structure so as to be readily removable to gain access to the reactor. The pressure tube extensions may penetrate the membrane, with a flexible bellows arrangement to seal the periphery of the membrane to the barrier to accommodate differential thermal expansion of the extensions and the containment structure, or may terminate below the membrane, the latter having access apertures closed by valves. Various means of pressure-relief are described. (CA)

14637 STATE OF GENTILLY NUCLEAR GENERATING STATION. Leger, P. A.; Monier, L. F. (Hydro-Quebec). pp vp of Proceedings of the 1972 Annual Conference of the Canadian Nuclear Association. Chalk River, Ont.; Atomic Energy of Canada Ltd. (1972). (In French).

From Canadian Nuclear Association 1972 annual conference; Ottawa, Ontario (11 Jun 1972). Paper No. 72-CNA-304.

Gentilly nuclear generating station is a prototype in the CANDU series: the reactor uses heavy water moderator, uranium dioxide fuel, and ordinary boiling water coolant. The steam generated in the reactor is conducted immediately to the turbine, condensed, and then returned directly to the reactor. This account discusses the state of the station, with particular attention directed to the main events of the last year. Some important experience gained at low to full power is briefly described. Experience in using certain systems is also presented. Increase of power above 50% was delayed to allow the design and installation of an additional system to protect against flux distortion. Full power was achieved on May 18, 1972. Knowledge acquired in the exploitation of Gentilly and the study of the experimental results have brought Gentilly reactor to the attention of several countries that are themselves concerned with this type of reactor. On the strength of the experience gained with nuclear and conventional components, the design engineer will be in a better position to evaluate the economic viability of such a concept. Gentilly reactor will then have achieved its main purpose as the prototype for a full-scale reactor. (CA)

Power Reactors, Breeding

Refer also to abstracts 13069, 14110, 14743, 14847, 14851, and 14875.

14638 (AI-AEC-13110) ANNUAL TECHNICAL PROGRESS REPORT: SODIUM TECHNOLOGY AND COVER GAS SEAL DEVELOPMENT PROGRAMS. Government Fiscal Year 1973. (Atomics International Div., Canoga Park, Calif. (USA)). 15 Sep 1973. Contract AT(04-3)-824. 191p. AT.

The development and performance testing of the FFTF vapor trap condenser and filter units are described. Cleaning and storage testing programs for liquid sodium coolant loop components are reviewed. Friction tests and evaluation of threaded fasteners for FFTF cooling system components are described. The formation of sodium oxide on surfaces in the FFTF cover gas space is analyzed. The testing of cover gas seals for LMFBR and FFTF cooling systems is reviewed. (DCC)

14639 (ANL-8036) EXPERIMENTAL EVALUATION OF FISSION-GAS RELEASE IN LMFBR SUBASSEMBLIES USING AN ELECTRICALLY HEATED TEST SECTION WITH SODIUM AS COOLANT. Wilson, R. E.; van Erp, J. B.; Chawla, T. C.; Kimont, E. L.; Baldwin, R. D. (Argonne National Lab., Ill. (USA)). Jul 1973. Contract W-31-109-eng-38. 55p. Dep. NTIS $5.45.

A description is given of an out-of-pile experiment which simulated fission-gas release in current-design uranium-oxide fuel subassemblies of liquid-metal-cooled fast breeder reactors (LMFBR's) and which was performed to evaluate the potential for pin-to-pin failure propagation due to thermal transients induced in adjacent fuel pins. A sodium-cooled test section containing three electrically heated pins was used. Gas (argon or xenon), injected as a jet through a needle protruding into the flow cross-sectional area of the test section, was made to impinge on one of the heater pins. Data are presented regarding the measured cladding-temperature rise and the calculated local heat-transfer coefficient in the impingement area, with the following parameters: gas type, needle internal diameter, heat flux, coolant flow rate, gas-plenum pressure and temperature, and axial location with respect to the gas jet. The cladding-temperature rises measured represent upper values, since the conditions under which they were obtained are conservative. There are two reasons for this: (a) The gas-release rates correspond to those that would prevail if the internal resistance to the flow of gas, between the gas plenum and the point of release of the fuel pin, were negligibly small; (b) the tests were performed under steady-state conditions, whereas, under actual reactor conditions, the gas-release rates would be decreasing with time because of the fixed fission-gas inventory. For a narrow range of gas-release rates under subsonic and near-subsonic conditions, cladding-temperature rises were found to occur in the impingement area, for the above conservative conditions, of up to ~240°C at a heat flux of 250 W/cm^2. (auth)

14640 (ANL-8043) PLUTO2: A PLUTONIUM SEGREGATION AND RESTRUCTURING SUBROUTINE. Meyer, R. O. (Argonne National Lab., Ill. (USA)). Oct 1973. Contract W-31-109-eng-38. 44p. Dep. NTIS $4.00.

A computer program has been written to describe plutonium segregation, density changes, and central-void development in irradiated mixed-oxide LMFBR fuels. The model on which the computer program is based depends on two mechanisms, vapor transport and sintering, that operate concurrently in the steep, radial temperature gradient that exists within the fuel. Two versions of the computer program are discussed in detail: PLUTO2, which runs as a subroutine of the LIFE-II fuel-element performance code, and LODESTAR, which is a self-sufficient program. Complete listings are given for both program versions, along with a dictionary of important variables and a sample output for each. 11 references. (auth)

14641 (ANL-CT-73-26) EVALUATION OF AVAILABLE EXPERIMENTAL RESULTS AND SERVICE PERFORMANCE DATA FOR MIXING COMPONENTS. Uherka, K. L. (Argonne National Lab., Ill. (USA)). Nov 1973. 74p. AT.

The open literature was surveyed and an evaluation was made of the available experimental and service-performance data related to mixing-tee components for LMFBR facilities. Consideration was given to a range of topics, which included: laboratory data on the thermal-fatigue characteristics of stainless steels, case histories involving fatigue failures of mixing tees during actual plant service, basic experimental data on turbulent fluctuations associated with fluid mixing, thermal-hydraulic characteristics of two intersecting fluid streams, and a review of various mixing-component design configurations presently in use. There are clear indications that the thermal stresses arising from temperature fluctuations associated with the turbulent mixing of two sodium streams, having large Reynolds numbers and inlet temperature differences of 200°F or more, can lead to fatigue failure of a mixing tee after about 10,000 h of operation. Thermal transients associated with plant startup-shutdown cycles have generally played only a secondary role in documented cases involving thermal-fatigue failure. While the use of thermal liners would alleviate somewhat the possibility of fatigue failure, additional laboratory measurements are needed to provide a solid basis for design judgments. In particular, laboratory data are needed concerning: the turbulent temperature fluctuations associated with mixing for various tee configurations and inlet-stream flowrates, and thermal-fatigue characteristics of stainless steel under temperature-cycling conditions which simulate the amplitudes and frequencies associated with turbulent mixing. On the basis of existing data, standard mixing tees have a relatively poor resistance to thermal-fatigue failure and more sophisticated designs should be used if continuous-service mixers

are needed in LMFBR piping systems. Several advanced component designs are reviewed which have potential applications for continuous-sodium mixing at inlet temperature differences up to approximately 400°F. 56 references. (auth)

14642 (BARC/I-190, pp 103-134) PHYSICS DESIGN OF FBTR. Singh, R. S.; Lee, S. M. (Bhabha Atomic Research Centre, Bombay). 1972.

A brief survey of some of the physics aspects in the design of the Fast Breeder Test Reactor being constructed at Kalpakkam, India is made. The objectives of the reactor and the consequent constraints placed on its physics design are first explained, and then some of the neutronics calculations which have been performed are described. (auth)

14643 (BNWL-tr-103) HANDLING APPARATUS FOR SODIUM-COOLED REACTOR INSTALLATIONS. Kirchner, G.; Jansing, W. (Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bensberg/Cologne (F. R. Germany)). 27 Nov 1973. Translated by E. R. Appleby from paper presented at reactor meeting, Deutsches Atomforum, Bonn, Germany, April 1, 1971. (CONF-710346-1). 19p. Dep. NTIS $3.00.

From reactor meeting; Bonn, Federal Republic of Germany (30 Mar 1971).

The remote-handling equipment for the KNK and SNR reactors is described. Testing procedures for the remote-handling equipment are discussed. (DCC)

14644 (EURFNR-1101) STUDIES ON THE CALCULATION OF DOPPLER COEFFICIENTS IN FAST REACTORS. Siep, I. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Neutronenphysik und Reaktortechnik). Apr 1973. 145p. (KFK-1778). Dep. NTIS $9.25.

Work performed under United States–Euratom Fast Reactor Exchange Program. Thesis. Submitted to Karlsruhe Univ.

A method is developed for the calculation of temperature-derivatives of effective group cross-sections in the resolved resonance region. By combination with the Karlsruhe code "DOP," which starts from statistical resonances, a program is obtained for direct calculation of (dkeff/dT) in the whole resonance region. Using this code the influence of different effects (e.g. exact treatment of the resolved resonances, of the asymmetric interference between resonance- and potential-scattering, influence of the weighting spectrum) on the Doppler Coefficient (DC) of a sodium cooled fast reactor is studied. Moreover a comparison of different computational methods for the DC is carried out. Finally (especially with regard to excursion calculations) the temperature dependence of the DC between 300 and 10000°K is investigated. 30 references. (auth)

14645 (INIS-mf-772) CNEN FAST REACTORS PROJECT. November 1971 Progress Report. (Instituto de Engenharia Nuclear, Rio de Janeiro (Brazil)). 1971. 17p. INIS.

Brief comments on the Brazilian fast reactor program are made. Planning, personnel, and other considerations are discussed. (auth)

14646 (ORNL-TM-4324) EFFECT OF PARTIAL BLOCKAGES IN SIMULATED LMFBR FUEL ASSEMBLIES. Fontana, M. H.; Kress, T. S.; Parsly, T. S.; Thomas, D. G.; Wantland, J. L. (Oak Ridge National Lab., Tenn. (USA)). Dec 1973. Contract W-7405-eng-26. 81p. AT.

Experimental data on the effects of partial blockages in simulated LMFBR rod bundles are reviewed and the results presented. Experiments performed in the ORNL Fuel Failure Mockup (FFM) with 13- and 24-channel inlet blockages in 19-rod sodium-cooled electrically heated rod bundles indicate that excessive temperatures do not occur as a result of the blockages. Similar experiments with 6-channel non-heat-generating blockages in the heated zone of the rod bundle indicate local temperature increases of ~100°F at full flow and linear heat ratings of 10 kW/ft. Calculations of temperatures within heat-generating blockages indicate that, with more than one subchannel blocked over an "infinite" length, resulting temperatures are above the cladding limit. Results from experiments with the FFM water mockup showed local heat transfer variations with 6-, 12-, and 24-channel central blockages and with edge blockages extending over one-third of the total area of the rod bundle. For this latter case, reductions in heat transfer coefficient to one-third of the free-stream value were observed. A simple representation of flow recirculation in the wake of a blockage indicates that a small recirculating flow significantly reduces temperatures in the wake zone. (auth)

14647 (WARD-RB-3045-3) RADIAL BLANKET DESIGN AND DEVELOPMENT. Quarterly Progress Report for Period Ending August 31, 1973. Bishop, E. C. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Nov 1973. Contract AT(11-1)-3045. 33p. AT.

The design and fabrication of a full size 7 rod radial blanket assembly for out-of-pile testing in a liquid sodium loop are described. Thermal and hydraulic characteristics of the 7 rod test assembly are presented. The liquid sodium test loop is described. The irradiation testing of radial blanket rods in the EBR-2 is reviewed. (DCC)

14648 (WAPD-TM-1126) THERMAL ANALYSIS OF ZIRCALOY-CLAD FUEL ROD END CAP WELDMENTS (LWBR DEVELOPMENT PROGRAM). Shuker, W. A. (Bettis Atomic Power Lab., Pittsburgh, Pa. (USA)). Nov 1973. Contract AT-11-1-GEN-14. 11p. Dep. NTIS $3.00.

Subsequent to the welding of Zircaloy-clad fuel rod end caps to the fuel rods, corrosion tests in 750°F steam showed a white line corrosion product on the inboard side of the weld while the outboard side remained free of corrosion. This behavior was attributed to different cooling rates on the two sides of the weld. A thermal model of the welding process was developed which predicted experimental behavior adequately and showed that the cooling rates on the two sides of the weld were different by a factor of three. Improvement of the cooling rates was shown to be possible by preheating the end cap. (4 references) (auth)

14649 PROCESS MEASURING TECHNIQUES IN FAST REACTOR SODIUM COOLANT LOOPS. Grunwald, G. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Kernenergie; 16: No. 5, 129-137(May 1973). (In German).

The well known and most promising techniques for measuring temperature, pressure, flow rate, and levels as well as for safety control in sodium coolant loops are described. Special properties of liquid sodium involved the development of new measuring techniques differing from the conventional process measuring techniques for many applications on principle. The most important measuring techniques are described and represented schematically. Trends of development are discussed. (43 references) (auth)

14650 INTERCOMPARISON OF NONPERTURBING TECHNIQUES FOR INFERRING THE REACTIVITY OF FAST REACTORS. Buhl, A. R. (Oak Ridge National Lab., TN); Robinson, J. C.; Tomlinson, E. T. Nucl. Technol.; 21: No. 1, 67-74(Jan 1974).

Numerical experiments were performed to evaluate the applicability of nonperturbing techniques for inferring the reactivity of fast reactors. Almost all such techniques contain the tacit assumption that the flux throughout the system is described by the fundamental mode and that higher modal contamination is negligible. Results were obtained for four reactive states of a typical 1000-liter-core Liquid Metal Fast Breeder Reactor (critical, -1$, -7$, and -30$) which illustrate the range of applicability of the point-model assumption with first-order corrections. 16 references. (auth)

14651 HEAT EXCHANGER. Fiebelmann, P.; Kottowski, H. (to EURATOM). Luxemburgian Patent 63,599. 23 Jul 1971. (In German).

Available from the Commission of European Communities, Luxembourg.

This heat exchanger has been particularly conceived for LMFRs (liquid metal cooled fast nuclear reactors) in which a direct contact between incompatible primary and secondary coolants in case of tube failures has to be avoided with security. A hermetically sealed pressure container is partly filled with a working medium. In this medium a tube bundle is dipped which is fed by the primary coolant, whereas above the liquid level of this medium a further tube bundle is arranged, being traversed by the secondary coolant. During operation the working medium performs a natural evaporation-condensation cycle between these bundles. In case of a tube failure this heat exchanger behaves like an intermediate cooling circuit without such expensive parts like pumps which otherwise would be necessary for such a circuit. Different constructive realizations of this heat exchanger concept as well as several detailed improvements are described. (EU)

14652 VALVES SELF CLOSABLE IN THE EVENT OF REVERSE FLOW, PARTICULARLY FOR FAST-FISSION LIQUID METAL COOLED FAST REACTORS. Seed, G.; Taylor, D. (to United Kingdom Atomic Energy Commission). British Patent 1,322,221. 4 Jul 1973. Filed date 6 Feb 1970. 5p.

The valve construction described comprises an elongated outer casing, with inlet and outlet connections, and a similar inner casing. The valve member, which is open in the absence of flow, or with forward flow, is self-closable in the event of reverse flow occurring at the outlet connection. An operating shaft is provided for purposefully closing the outlet port, together with seals for closing off the annulus between the inner and outer casings on both sides of the inlet connection. Application to a

liquid metal cooled fast reactor is described. The transverse dimension of the inner casing is a maximum at the seals, so that the casing can be slid into and out of the outer casing together with the valve member and operating shaft. A gas disentrainment device is provided for disentraining gas from the liquid metal flowing through the valve and exhausting it along the inside of the inner casing. The inlet may comprise longitudinal perforations in the inner casing, covered with wire gauze, and the valve member may be provided with a damper to allow controlled and smooth movement of the valve member to the closed position under reverse flow conditions. (UK)

14653 RESEARCH AND DEVELOPMENT OF COMMERCIAL DEMONSTRATION FAST BREEDER REACTOR. Nakagawa, H.; Naito, F. (Tokyo Electrical Power Co., Inc.). Genshiryoku Kogyo; 19: No. 1, 45-51(Jan 1973). (In Japanese).

The research and development of commercial fast breeder reactors based on incorporating some complementary proposals into the design of "Joyo" and "Monju" are described. In big reactors, hot-cell type exchange systems must be used for spent fuels which have high decay-heats of from 30 to 50 kW. Bent-fuel must be utilized for attaining high burn-up of the fuel and for obtaining high outlet temperature. Material for a steam generator must be reconsidered, since the accidents with sodium-water reaction are still reported around the world. In the scale-up of various machine parts, former thermal stress standards must be revised due to increased thickness. Problems related to the swelling of stainless steel at a neutron flux of about 10^{23} nvt must be studied. The sodium void factor, Doppler factor and others must be correctly estimated. Research and development on the fuel-melting detection system must be performed. (JA)

14654 PROBLEMS ON NUCLEAR REACTOR STRUCTURE AT ELEVATED TEMPERATURE. Hasegawa, M. (Waseda Univ., Tokyo); Suzuki, H.; Fujimura, T.; Uga, T.; Miyazono, S. Nippon Genshiryoku Gakkaishi; 14: No. 11, 619-639(Nov 1972). (In Japanese).

In cases of fast breeder reactors, high temperature gas-cooled reactors and nuclear fusion reactors, technical methods and standards employed for light water reactors must be reconsidered in view of reactor design and safety because operation temperature is lower than the above mentioned new type reactors. Problems on the materials and design of fuel, reactor core, reactor pressure vessels and piping system in primary system are introduced and examined. As to the reactor core and the core materials, present status and problems on fuel temperature, coated particles of fuel, carbon material for fuel assembly, graphite moderator, and heat-insulating material are introduced. As for the structural materials used at high temperature, stability of the materials against the irradiation of neutrons, strength and ductility, corrosion resistance to coolant, and workability including weldability are necessary. From the standpoint of structure design, emphasis must be laid on the design of high temperature parts rather than pressure boundaries. Examination in detail is under way on the extension of conventional structure design method to high temperature, material strength at high temperature, application of creep strength to design, mutual relation of high temperature fatigue failure and creep failure, acceleration of deformation by thermal ratchet and thermal load, and creep buckling. (JA)

14655 DEVELOPMENT OF ELECTROCHEMICAL MEASURING TECHNIQUES FOR MONITORING DETRIMENTAL IMPURITIES IN SODIUM COOLANT LOOPS. Ullmann, H.; Teske, K.; Reetz, T. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Kernenergie; 16: No. 9, 291-297(Sep 1973). (In German).

Out of the impurities occurring in sodium coolant loops especially oxygen, hydrogen, and carbon are dangerous for a safe operation of the plants. Therefore, the monitoring methods hitherto used have to be improved further. Using solid electrolyte voltaic cells the oxide content of sodium can be measured with high sensitivity and selectivity. The hydrogen content of sodium is in equilibrium with the hydrogen content of the argon inert gas. Its measurement can, therefore, be carried out in the gas phase, using a solid electrolytic cell as well. Monitoring of the inert gas system with respect to its tightness and purity relative to oxygen can be conducted with advantage by means of a voltaic cell. Construction and status of the development of measuring techniques are described. Their information content is discussed. (46 references) (auth)

14656 TECHNICAL AND ECONOMIC STUDIES ON THE STARTUP OF FAST BREEDERS WITH PLUTONIUM OR ^{233}U. Wenzel, P. (ORGREB, Berlin). Kernenergie; 16: No. 9, 266-270 (Sep 1973). (In German).

The amounts of fissile materials in the form of ^{239}Pu or ^{233}U necessary for the startup and transient régime of a fast breeder reactor are determined and compared with each other using an analytical model. With that, the most important physico-technical parameters of the reactor, in particular the different critical masses and breeding factors for the two different fissile materials, the operating characteristics of the reactor, and the parameters of the external fuel cycle are taken into consideration. The algorithm given enables a large number of survey calculations with relatively small effort and may serve for optimizing the parameters introduced into the calculations and for evaluating a system-related plutonium price on the basis of that of uranium. (4 references) (auth)

14657 MATHEMATICAL GAME FOR SECONDARY FAST REACTOR OPTIMIZATION. Pavelescu, M.; Dumitrescu, H.; Adam, S. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 18: No. 8, 1007-1014(1973).

By definition, fast secondary reactors are the fast reactors with an initial breeding ratio smaller than unity. These reactors are mainly destined to power production. They can be built up after sufficient fissile material is obtained in the fast breeder reactors, as the second stage of the nuclear energetics development. The secondary fast reactor of the largest possible power at the expense of the smallest possible critical mass for a given fertile-material mass is analyzed. It is shown that this is a typical two-matrix-game problem. (5 references) (auth)

14658 CURRENT STATUS OF GAS-COOLED FAST REACTORS. Krasin, A. K.; Sharovarov, G. A. (Inst. of Nuclear Energy, Minsk). Vestsi Akad. Navuk Belarus. SSR, Ser. Fiz.-Energ. Navuk; No. 2, 26-29(1973). (In Russian).

The current status of gas-cooled fast reactor development after the first IAEA group meeting on gas-cooled fast breeders in Minsk, July 24-28, 1972, is discussed. (auth)

14659 CONTRIBUTION OF THE CASACCIA CENTER TO THE R AND D ACTIVITIES OF ITALY'S FAST-REACTOR PROGRAM. Bianchi, G.; Fizzotti, C. (CNEN, Casaccia, Italy). Com. Naz. Energ. Nucl., Notiz.; 19: No. 8-9, 47-75(1973). (In Italian).

Research activities underway at the Casaccia Nuclear Research Center in support of the Italian Fast Reactor Program are discussed. These activities include: component research and development and the design of the PEC reactor; safety studies of the PEC reactor; research and development in support of fuel element design and fabrication; and research and experiments on sodium plant components for fast reactors. (auth)

14660 DEVICE FOR LOCATING A FUEL ASSEMBLY CAN FAILURE IN A NUCLEAR REACTOR. Delisle, J. P.; Rulleau, A.; Prouteau, L. (to Commissariat a l'Energie Atomique). US Patent 3,775,245. 27 Nov 1973. Priority Date 22 Sep 1970, France. 8p.

The device comprises a plate for the distribution of tubes which serve to sample the coolant within all the fuel assemblies, a first selector which is mounted above the distribution plate and traversed by ducts for providing a communication between a number of sampling tubes and a second selector which is mounted above the first selector. The ducts are connected either individually or simultaneously to a measuring apparatus by means of the second selector. Both selectors are supported by a removable neutron shield plug. (Official Gazette)

14661 COOLANT SYSTEMS FOR NUCLEAR REACTORS. Gratton, C. P. (to United Kingdom Atomic Energy Authority). US Patent 3,773,618. 20 Nov 1973. Priority Date 7 Feb 1968, United Kingdom of Great Britain and Northern Ireland. 4p.

In some reactors the fuel can be run at temperatures above that required by the heat utilization plant to which the coolant is supplied. In these reactors a saving in pumping power may be achieved by raising only part of the coolant to core inlet pressure and bypassing the rest around the heat emitting part of the core. The by-pass stream is mixed with the hot outlet coolant at the core outlet to give a bulk coolant at the required temperature. (Official Gazette)

Research, Test, and Experimental Reactors

Refer also to abstracts 12776, 14638, 14643, 14646, 14735, and 14793.

14662 (ANL-7639) VARIABLE-TEMPERATURE RODDED ZONE PROJECT: DESIGN SUMMARY REPORT. Lewis, R. A.; Dance, K. D.; Meyer, J. F.; Groh, E. F.; Bohn, E. M. (Argonne National Lab., Ill. (USA)). Oct 1972. Contract W-31-109-eng-38. 251p. Dep. NTIS $7.60.

All aspects of the design of the Variable Temperature Rodded

Zone (VTRZ) and the principal engineering analyses and laboratory tests upon which the design is based are summarized. The VTRZ design described represents the design at the end of the formal Design and Development Phase. Changes made in the VTRZ design as a result of experience gained in the preoperational testing will be described in a later document. A systematic reference source on VTRZ design for use in subsequent installation, operation, maintenance, and modification phases of the VTRZ project is presented. (9 references) (auth)

14663 (ANL-CT-73-18) EXPERIMENTALLY DETERMINED SHEAR PROPERTIES OF ROTARY-MOTION SODIUM FREEZE SEALS. Folkrod, J. R.; Misra, B.; Rohde, R. R. (Argonne National Lab., Ill. (USA)). Sep 1973. 37p. Dep. NTIS $4.00.

An experimental project in support of the FFTF primary valve and the SPTF flow control valve was conducted to measure the shear properties of sodium with rotary stem motion for the sodium freeze seals used for these valves. Bench type experiments were performed using test specimens with freeze-seal dimensions and temperatures representative of the range of parameters of interest to the FFTF program. Sodium shear data were obtained and correlated. A general correlation for both the "peak" or breakaway shear and for a "running" or uniform rotational stem speed is provided. The tests proved that the type of stem motion, linear or rotary, does not influence the value of the sodium shear. 3 references. (auth)

14664 (AWRE-O-57-73) NEUTRON SCATTERING INSTRUMENTS ON THE RESEARCH REACTOR HERALD AT AWRE, ALDERMASTON. Reichelt, J. M. A.; Rodgers, A. L. (UKAEA Weapons Group, Aldermaston. Atomic Weapons Research Establishment). Dec 1973. 60p. Dep. NTIS (U.S. Sales Only) $5.00. UK £1.

A general description is given of the neutron beam instruments on the HERALD reactor with examples of their applications to materials science. The instruments consist of a variety of neutron diffractometers and spectrometers which are used to study the atomic structure and motions in solids and liquids. Three of the facilities belong to AWRE, and five are owned by the Science Research Council (SRC) for University programs of research. The SRC equipment has largely been developed and installed by AWRE to specifications which have been provided by University groups and approved by the Neutron Beam Research Committee of the SRC. The disposition of the neutron beam equipment on the reactor is shown in a horizontal section of the reactor through the median plane of the core. The position is also shown of the cold neutron source in a tangential tube, enabling it to provide enhanced fluxes of long wavelength neutrons for two instruments simultaneously. (UK)

14665 (BARC/I-190, pp 196-266) PULSED FAST REACTOR AND THE ASSOCIATED CRITICAL FACILITY. Kapil, S. K. (Bhabha Atomic Research Centre, Bombay). 1972.

Since the fission process in nuclear reactors is the prime source of neutrons for experimental purposes, the relative merits of power reactors for such purposes are reviewed in relation to their design, specification, etc. The preference for the pulsed sources over others for a certain class of experiments is explained. Various types of pulsed sources (the periodically pulsed ones in particular) are discussed and their optimum design parameters are estimated. A comparison of the existing designs is also included. The physics problems connected with the design of a pulsed fast reactor to be constructed in India have been discussed by designing a close mock-up of the proposed reactor. Details of the experimental optimization of some of the design parameters, such as choice of reflector, fuel, lattice spacing system configuration, location of safety rods, grids, and dummy pins, etc. are presented. Mention is made of the various computer codes used in these calculations. (INIS)

14666 (COO-2144-6) UNIVERSITY OF WISCONSIN REACTOR SHARING PROGRAM. Technical Progress Report, April 1, 1973–December 8, 1973. (Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering). 1973. Contract AT(11-1)-2144. 29p. Dep. NTIS $3.50.

Activities in the Reactor Sharing Program at the University of Wisconsin are summarized. The activities were primarily of an instructional nature. (JWR)

14667 (GEAP-13930) FLOW OSCILLATOR AND BALANCED OSCILLATOR TEST IN SEFOR. Lu, Y. S. (General Electric Co., Sunnyvale, Calif. (USA). Breeder Reactor Dept.). Jan 1973. Contract AT(04-3)-540. 133p. Dep. NTIS $8.76.

The Southwest Experimental Fast Oxide Reactor (SEFOR) was designed for the systematic determination of the Doppler coefficient of reactivity at temperatures to the vicinity of fuel melting, and the experimental program was comprised of a series of tests for the Core I and Core II. The flow oscillation and balanced oscillator tests were included in the program and designed to verify the dynamic behavior of the reactor system and the power coefficient α_t. A mathematical model describing the system in the frequency domain was used to calculate the dynamic responses of the reactor system. The results obtained from the Core II primary flow oscillations were compared with the calculations, and a reasonably good agreement was obtained. The values of the power coefficient, α_t, obtained from the first balanced oscillator tests were 11 to 15% higher than those obtained from the conventional oscillator tests. It appears that the discrepancies are generally within the uncertainties associated with the conventional oscillators tests. The results obtained from the second balanced oscillator tests for the values of the reactivity feedback do not agree with the predicted values because of the unreliability of the coolant temperature thermocouple readings. (auth)

14668 (HEDL-SA-661) SODIUM REMOVAL PROCESSES AND MATERIAL REQUALIFICATION FOR LMFBR HARDWARE. Borisch, R. R.; Maffei, H. P. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 1973. Contract AT(45-1)-2170. 15p. (CONF-740301-1). Dep. NTIS $3.00.

From NACE meeting–corrosion/74; Chicago, Illinois, USA (4 Mar 1974).

The moist nitrogen process for removing residual sodium from large components is described. Potential problems, including rusting and caustic stress corrosion cracking, and suggested methods of eliminating the problems are presented. The reaction, rinse, and dry stages of the sodium removal process are dealt with separately. Examples of theoretical component temperatures for uncontrolled reactions are compared to theoretical maximum temperatures for the controlled moist nitrogen process. Some general empirical rules are presented for removing sodium from crevices. (auth)

14669 (HEDL-TME-73-32) RATE OF SODIUM REMOVAL FROM CREVICES IN FFTF/LMFBR EQUIPMENT. Borisch, R. R.; Maffei, H. P. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Nov. 1973. Contract AT(45-1)-2170. 15p. Dep. NTIS $4.00.

Development has been performed for removal of sodium from small annular crevices similar to those in the FFTF IHX and In-Vessel Handling Machine. The steam-nitrogen, alcohol, and evaporative processes were evaluated for this application, and the steam-nitrogen process was selected. The tests have shown that, through use of the steam-nitrogen process, sodium can be reliably and repeatedly removed from annular crevices with diametral widths from 2 to 58 mils, and with depths of six to eight inches. Work is continuing to define explicitly the conditions required to assure that caustic cracking will not result from the cleaning operations or from subsequent maintenance and storage operations. (auth)

14670 (HW-43547) HANFORD TEST PILE. Davis, M. V.; Fowler, H. A. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 7 Jun 1956. Contract W-31-109-Eng-52. 57p. Dep. NTIS $5.00.

Declassified 8 Jan 1973.

The Hanford Test Pile and the operating procedures used for the pile are described. The results of calibration measurements are presented. (JWR)

14671 (IAEA-R-684-F) DETERMINATION OF PRECISE NEUTRON TEMPERATURE IN NUCLEAR REACTORS BY FISSION TRACK DETECTORS. Final Report for the Period 1 October 1968–30 November 1971. Su, C. S. (International Atomic Energy Agency, Vienna (Austria)). 1972. 49p. INIS.

Neutron temperature measurements have been performed at different power levels in the reactor core, water moderator region and thermal column of the Tsing Hua Open Pool Reactor by means of a nuclear track detection method developed at the Institute of Nuclear Science, National Tsing Hua University. The developed method is based on the measurement of the fission cross-sections ratio of ^{235}U and ^{239}Pu by counting the induced fission tracks registered in mica and glass fission detectors. The weight ratio of ^{235}U to ^{239}Pu was calibrated in the thermal column with a Maxwellian distribution and with a neutron temperature essentially equal to the medium temperature. The simplicity and reliability of the method is discussed together with its advantages such as no significant flux distortion induced from the monitors and no background tracks from alpha particles protons or gamma radiation. The dependence of the resolution and the number of tracks, for proper counting and good statistics, on the integrated flux, is also discussed. The major difficulty of this method being the fission track counting by eye observation of a large number of tracks in order to obtain good statistics. Automatic counting of fission tracks is discussed and further development is suggested. (INIS)

14672 (JAPFNR-124) EXPERIMENT AND ANALYSIS OF B_4C SIMULATING CONTROL ROD ON FCA V-3 ASSEMBLY. I. Neutron Source Multiplication Method. Mizoo, N.; Matsuno, Y.; Maekawa, H.; Iijima, T.; Kobayashi, K.; Nakamura, T.; Hirota, J. (Japan Atomic Energy Research Inst., Tokyo). Mar 1972. 111p. (PNC-J-250; JAERI-Memo-4790). Dep. NTIS (U. S. Sales Only) $7.75.

For Power Reactor and Nuclear Fuel Development Corp., Tokyo.

Reactivity worths of the B_4C simulating control rods were measured and analyzed in the FCA V-3 Assembly which is the mockup for JOYO. Assembly V-3 differs from JOYO in the blanket composition and the simulating control rod is $\frac{1}{2}$ of that of JOYO in size. Efforts were made to check the adequacy of the nuclear design method and to improve the design accuracy for JOYO by determining the range of ratios of the theoretical to experimental values (C/E). The lowest limit of the subcriticality of the system is -6% δk/k and the C/E ranges from 1.00 to 1.03. (auth)

14673 (JINR-P3-7457) PRODUCTION OF ULTRACOLD NEUTRONS (UCN) IN A STATIONARY REACTOR BBP-K. Akhmetov, E. Z.; Kaipov, D. K.; Konks, V. A.; Lushchikov, V. I.; Pokotilovskii, Yu. N.; Strelkov, A. V.; Shapiro, F. L. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 12p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

A source of ultracold neutrons is described, formed in a straight-through horizontal tangent channel of a stationary reactor BBP-K. The rate of counting of UCN with the converters of H_2O, $ZrH_{1.92}$,Mg, the dependence of the UCN yield on the temperature of Mg-converter, and the mean time of UCN distribution on the neutron guide tube from the converter to detector are presented. The ways of increasing the UCN yield are considered. 9 references. (auth)

14674 (NIIAR-P-139) EFFECT OF THE PARTIAL FUEL OVERLOAD ON THE HIGH-FLUX TRAP-TYPE REACTOR PERFORMANCE. Taykanov, V. A. (Scientific Research Atomic Reactor Inst., Melekess (USSR)). 1972. 20p. (In Russian). INIS.

Partial fuel overload in the active zone of a research reactor may be used either to increase the fuel burnup in the assembly for a given volume of the active zone of a reactor and thermal power, or to decrease the volume of the active zone and thermal reactor power without a loss in burnup. Both possibilities are considered and an analysis is carried out on the effect of partial fuel overloading on other characteristics of the reactor: reactor use coefficient, optimum burnup, etc. It is concluded that partial fuel overloading is feasible for use on high-flux reactors of the trap type. (auth)

14675 (NP-19894) FACILITIES FOR HIGH TEMPERATURE REACTOR STUDIES AT HARWELL. Williams, J. (comp.). (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). 1973. 40p. Dep. NTIS (U. S. Sales Only) $4.00.

Harwell has been engaged in work in support of the High Temperature Reactor Program in the UK for many years and has thus built up a whole range of facilities and expertise which can be made available to external customers. The specific areas of work are: testing of graphite, fuel particles and fuel assemblies in Material Testing Reactors (such as DIDO and PLUTO) and Dounreay Fast Reactor in both static rigs and gas cooled loops; complete range of post-irradiation examination covering all aspects of mechanical and fission product behavior (this covers the whole spectrum from dealing with individual particles to complete fuel pins); and supporting laboratory studies and assessment studies on particle endurance and fission product behavior. Some of the facilities available for this work are described. (auth)

14676 SOME ADVANTAGES OF THE MODEL OF REACTOR DYNAMICS BASED ON POWER FEEDBACK. Bouzhik, Ya.; Gadomski, A.; Topa, E. (Inst. of Nuclear Research, Swierk, Poland). Kernenergie; 16: No. 5, 144-147 (May 1973). (In Russian).

An approach to the model of reactor dynamics of a research reactor based on the power feedback only is presented. The advantages of such an approach are studied. The results are compared with some experimental data. The dynamical model developed and the numerical programmes elaborated on its basis have been applied to evaluate the reactivity of control rods in reactors working on various-power levels. 3 references. (auth)

14677 REACTIVITY DETERMINATION OF A WEAKLY COUPLED TWO-CORE-SYSTEM. Roethemeyer, H. Stuttgart; Univ., Stuttgart (1971). 97p. (In German).

Thesis.

The "Research and Measuring Reactor" (FMRB) of the Physikalisch-Technischen Bundesanstalt is operated with two MTR-Cores weakly coupled by a heavy water tank. The properties of this configuration have been investigated by applying pulsed source and asymptotic period techniques. Reactivities determined by pulsed source measurements display large statistical uncertainties. This is due to delay-time dependent coupling effects. The errors can be avoided by determining the reactivities of the two uncoupled (isolated) cores and calculating their influence on the coupled core configuration with a two point reactor model. The period method of determining reactivity is applicable with the same accuracy as in single core reactors. The influence of reactivity perturbations depends on the power ratio of the two cores, but is always less than the effect of the same perturbations in the single isolated cores. The measured reactivity-properties are in agreement with the predictions of a two-point reactor model. (GE)

14678 TASKS OF NUCLEAR RESEARCH CENTERS WITHIN THE FRAMEWORK OF FUTURE DEVELOPMENT PROGRAMS FOR NUCLEAR ENERGY. Schmidt-Kuester, W. J. Hamburg; Thiemig (1973). 22p. (In German).

From annual meeting of the Kernenergie-Studiengesellschaft; Hamburg (11 Dec 1972).

Following a historical review of the especially government-supported development of nuclear technology in the FRG since 1955, a report is given on the future nuclear reactor programme from the economic aspect. The main points of the thus entailed research in the individual research centres and the planning of the fourth German atomic programme are then explained. Finally, a few organizational measures, the gradual taking over of non-nuclear tasks, as well as contract research/diversification are discussed. (GE)

14679 EXPERIMENTAL ANALYSIS OF THE THERMAL-HYDRAULIC PERFORMANCE OF FLAT RECTANGULAR FLOW CHANNELS TYPICAL OF POOL REACTORS. Guerrero, H. N. Charlottesville, VA; Univ. of Virginia (1973). 251p. University Microfilms Order No. 73-25,017.

Thesis (Ph. D.).

An experimental program was initiated to evaluate the thermal-hydraulic performance of rectangular flow channels similar to those found in the University of Virginia Reactor (UVAR). In particular, the simultaneous effects of the following factors present in the UVAR-flow velocities in the transitional region, downflow, rectangular geometry, and entrance effects were the subject of the investigation. A heat transfer facility was designed and constructed suitable for studying safety-related problems of heat transfer in pool reactors. A UVAR flow channel is simulated with an aluminum test section where heating is accomplished with electrical heaters. Water is circulated at controlled pressure, temperature, and rate of flow in a test loop which includes the test section. Local heat transfer coefficients were obtained for a $\frac{1}{4}$-in. × $\frac{3}{4}$-in. channel for various conditions. The data in the Reynolds number range $5000 < N_{Re} < 18{,}000$ yield heat transfer coefficients 7.5-18% lower than predicted coefficients by the Hausen correlation. In the low Reynolds number range $1700 < N_{Re} < 5000$ heat transfer coefficients are considerably larger than would be expected from applying forced convection correlations in this region. An empirical correlation is presented for this region which includes dimensionless groupings similar to those valid for pure free convection. Thermal starting lengths occupying half the test section length and extending over longer portions as flow velocity is decreased are larger than previously reported values for round tubes. The variation of the heat transfer coefficient in the entrance regions of the channel can be explained on the basis of the development of the boundary layers. Preliminary experiments were also performed where the instrumentation and techniques applicable to the determination of inception of boiling, critical heat flux and flow instability were developed. (Diss. Abstr. Int., B)

14680 MEASUREMENT OF THE RESIDUAL POWER OF RAPSODIE-FORTISSIMO FUEL ELEMENTS USING CALORIMETRY. Devillers, C.; N'Guyen Van Dat. (CEN de Saclay, Gif-sur-Yvette, France). Bull. Inform. Sci. Tech. (Paris); No. 181, 41-50 (May 1973). (In French).

A calorimetric method is proposed for measuring the residual power of fast reactor fuel pins. Calculations of the energy released by the fission products give results which are in satisfactory agreement with calorimetric measurements; corrections must, however, be made for parasitic activities (α emission from transuranic elements, β and γ emission from the cladding) and γ losses. This agreement suggests that the determination of the mean specific burnup of a pin could be determined from calorimetric measurement of its residual power. (FR)

14681 DYNAMIC RESPONSE STUDIES UTILIZING INHERENT NOISE AND ANALYTICAL TRANSFER FUNCTIONS FOR THE EXPERIMENTAL BREEDER REACTOR-II. Noggle, L. W. Columbus,

OH; Ohio State Univ. (1973). 229p. University Microfilms Order No. 73-26,882.

Thesis (Ph.D.)

The major noise sources inherent to the Experimental Breeder Reaction-II (EBR-II) were investigated for their usefulness in experimentally determining the reactor's transfer functions; and an explanation was sought for the source of a nominal 10 Hz. oscillation observed over several years in the power trace of the EBR-II. Four major noise sources, i.e., fission noise, control rod mechanical vibrations, inlet temperature fluctuations, and flow rate variations, were identified in the EBR-II and evaluated. The evaluations were conducted considering both natural and forced oscillations of the sources. Computer programs were developed to calculate the auto and cross-correlation functions, power spectral densities, and transfer functions. The power spectral densities were obtained from the Fast Fourier Transforms of the experimental data. Analytical transfer functions were derived from a simplified mathematical model to study EBR-II feedback effects and to obtain parametric data. The model was based upon point kinetics with both fuel and coolant temperature feedback and gave good agreement with frequency response data obtained from rod oscillator tests on EBR-II. None of the noise sources were found suitable for measuring EBR-II transfer functions because of instrumentation (presently installed) limitations; however, all appeared to be suitable for future liquid metal reactor systems which could employ instruments having the required characteristics. The character and the source of the 10 Hz. noise were fully investigated. The source of the 10 Hz. noise was satisfactorily explained as mechanical vibration of various EBR-II subassemblies. The correlation of mechanical vibration of reactor control rods and observed power oscillations was confirmed experimentally. (Diss. Abstr. Int., B.)

Production and Materials Testing and Processing Reactors

Refer also to abstracts 13142 and 14854.

14682 (DUN-5870) IN-PLACE TEST PROCEDURE FOR CONFINEMENT CHARCOAL FILTERS. Hirschel, D. L. (Douglas United Nuclear, Inc., Richland, Wash. (USA)). 22 Sep 1969. Contract AT(45-1)-1857. 42p. Dep. NTIS $4.25.

The operating reactors (KE, KW, and N) at Hanford are equipped with a confinement facility and associated equipment designed to control and entrap the radioactive materials which would be present in the exhaust system in the event of a reactor incident. These facilities include the fog spray system, exhaust fans, associated ductwork, monitoring devices for automatic activation of the systems and a series of filter banks. The primary purpose of this facility is to provide protection by ensuring the filtration of all exhaust air prior to its release to the atmosphere. One of the primary release considerations is the removal of radioiodine which would be present in the event of a reactor fuel meltdown incident and is a definite biological hazard. In order to achieve a high degree of reliability and to ensure proper maintenance of the systems which provide for iodine removal (confinement system charcoal filters) a reliable inspection, testing and maintenance program is essential. A test procedure is described which will determine the capability of the charcoal filters to remove radioiodine from the exhaust gases prior to their release to the atmosphere. (auth)

14683 (HW-53615) THERMAL NEUTRON FLUX RATIOS IN CLUSTER ELEMENTS. Nilson, R.; Chitwood, R. A. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 15 Nov 1957. 3p. Dep. NTIS $3.00.

Declassified 8 Jan 1973.

Seven rod cluster fuel elements are currently being considered as one of the fuel candidates for the 771 program (NPR) reactor. To study the heat transfer properties of such fuel elements, it is necessary to know the expected ratio of thermal fluxes in the fuel members of the cluster. A simple method of calculating $\bar{\phi}_o/\bar{\phi}_i$, the ratio of average flux in the outer rods to that in the central rod, is presented. A calculated ratio with an experimentally determined ratio for a seven-rod cluster is included. (auth)

14684 (HW-67771-RD) WARP IN NPR FUEL ELEMENTS. Guay, A. E. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 14 Dec 1960. Contract AT(45-1)-1350. 19p. Dep. NTIS $3.00.

Declassified 8 Jan 1973.

Warp of NPR fuel elements during fabrication was studied. It is concluded that the warp results from beta heat treatment. The warp is especially pronounced with the NPR-1T geometry. (DLC)

14685 (HW-71784) NPR BOILING BURNOUT EXPERIMENTS: PRELIMINARY ANALYSIS. Anderson, J. K.; Thorne, W. L.; Batch, J. M. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 15 Nov 1961. 10p. Dep. NTIS $3.00.

Declassified 4 Apr 1973.

Some boiling burnout data and the application of these data to NPR fuel elements under typical reactor operating conditions are presented. (auth)

14686 (HW-77391) NPR DUMP CONDENSER BOILING ANALYSIS. Muraoka, J. (Douglas United Nuclear, Inc., Richland, Wash. (USA)). 25 Apr 1963. 8p. Dep. NTIS $3.00.

Declassified 4 Apr 1973.

During normal NPR operation, four circulating water pumps are in service in the tertiary coolant system. These pumps supply the secondary coolant to the dump condensers, turbine generator surface condensers, and primary pump drive turbine condensers. At certain times it may be necessary to operate at full power with one pump shut down for maintenance. If during such an operating period a BPA power outage were to occur, in the worst case only one circulating pump will remain in service. The consequences of bulk boiling in the tertiary system were examined during the transient following loss of two of the three operating pumps. The effect on the secondary steam pressure was of particular interest. (auth)

14687 (HW-77470) BURNOUT HEAT FLUXES FOR NPR TUBE-IN-TUBE FUEL ELEMENTS. Anderson, J. K.; Thorne, W. L.; Batch, J. M. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 12 Jun 1963. 48p. Dep. NTIS $4.50.

Declassified 8 Jan 1973.

A common criterion for nuclear reactors is that operating conditions should always be less severe than those which could produce boiling burnout and cause extensive damage to fuel elements. The present knowledge of boiling heat transfer is not sufficient to allow predictions of boiling burnout conditions by theoretical means. Even the use of equations representing correlations of experimental data is not sufficiently accurate for a reactor design different from the configurations used in obtaining the data. Therefore, experiments were performed in the 189-D Heat Transfer Laboratory to define the boiling burnout conditions for the NPR. Results of these experiments are presented. (auth)

14688 PROCEDURE FOR CONTROLLING THE SPEED OF INTRODUCTION AND REMOVAL OF CAPSULES IN THE CORE OF A REACTOR OR NEUTRON GENERATOR AND PNEUMATIC INSTALLATION FOR PUTTING THE PROCESS IN OPERATION. Dieck, L. E. (to Kernforschungsanlage Juelich GmbH). German Patent 1,910,522. 11 Feb 1971. Filed date 1 Mar 1969. (In German).

The closed capsules containing substances to be irradiated are moved pneumatically, led by means of a conduit into the irradiation region of a nuclear reactor or neutron generator, the speed of the capsules being regulated by changing the air pressure in the transport channel by means of valves that are found in connection with the transport channels, or closing devices or similar devices acting transversely at the time of passage of the capsules in the direction determined, with commutators connected with the already known control devices. (TSS)

14689 IRRADIATION INSTALLATION WITH PNEUMATIC TUBE SYSTEM. Maier-Borst, W.; Lorenz, W.; Krauss, O.; Waelischmiller, H. German Patent 1,804,126. 27 May 1970. Filed date 19 Oct 1968. (In German).

A description is given of an irradiation installation with a pneumatic tube system that serves to transport samples for irradiation to an irradiation receptacle located in the pool of a swimming pool reactor, preferably a rotating irradiation. It is characterized by the fact that the transport agent for the capsule in the pneumatic tube is the liquid coolant located in the pool of the reactor. (TSS)

14690 HIGH TEMPERATURE HELIUM HEAT EXCHANGER LOOP. (Ishikawajima-Harima Heavy Industries Co. Ltd., Tokyo). Ishikawajima-Harima Giho; 13: No. 3, 349-357(May 1973). (In Japanese).

There exists in the high temperature heat exchanger as well as the steam reformer, several technical problems to be solved before realizing a nuclear plant complex for iron and steel making. The loop which is described was planned for basic studies and turned over to IHI for its actual construction. The loop was designed, manufactured and installed for research on heat exchange between helium and steam, hydrogen permeation through heat-resisting alloys, hydrogen removal using a titanium sponge, and creep and carburization of heat-resisting alloys. A summary of the entire project from design to test operation of the loop is re-

ported. The primary coolant used was helium having a pressure of 12 kg/cm²g and a measured temperature of 1100°C at the inlet of the high temperature heat exchanger test section. Steam, hydrogen and carbon monoxide were used as secondary coolants. (auth)

14691 PROGRESS WITH THE SOLID MODERATED REACTOR (S.M.R.). Atom (London); No. 202, 184-186(Aug 1973).

The Solid Moderated Reactor is a 500 watt graphite moderated reactor fuelled with plates of highly enriched U alloyed with Al. It was designed to provide on-line measurement of the burn-up of fuel spheres as discharged from the 300 MW(e) Thorium High Temperature pebble bed reactor (THTR) being built in Germany, for which there is a need for an immediate determination of burn-up as a sphere leaves the core, in order to settle its further handling, this being achieved by measuring its reactivity through the perturbation produced in the neutron flux of a low power reactor by passage of the sphere through its core. A contract was awarded to the UKAEA to supply the SMR for this purpose. The reactor can be installed in a confined space of area about 800 mm square. In order to demonstrate that a solid moderated reactor would meet the requirements a reactor core of the type proposed was installed in the zero energy facility Hector at AEE, Winfrith, incorporating a mechanism for moving dummy fuel spheres containing various mixtures of fertile, fissile and absorber material in and out of the core. Measurements confirmed that the requirements should be obtainable. A requirement is that the initial fuel charge should last for a reactor lifetime of 30 years, and no provision is made for refuelling. The neutron flux is 10^{16}n/cm²/sec. A brief description of the reactor is given. The SMR structure will be located within the main THTR containment. An on-line digital computer is provided for analysis purposes, and sphere burn-up determined relative to standard calibration samples. Detailed design is complete, and the manufacture of components is proceeding. The SMR could also be modified to measure accurately and rapidly any property effecting reactivity. (UK)

Propulsion and Package Reactors

Refer also to abstracts 13066, 13067, 13074, 14850, 14853, and 14855.

14692 (APEX-350) GE-ANPD REVISED ANNUAL PROGRAM REPORT: USAF CONTRACT YEAR 1957, 1958, 1959; USAEC FISCAL YEAR 1957, 1958, 1959. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). 10 Jan 1958. Contract AT(11-1)-171. 128p. Dep. NTIS $8.50.

Declassified 12 Sep 1973.

The development, design, fabrication, and preparation for the all-nuclear flight of the XMA-1 nuclear propulsion reactor are described. Heat transfer tests and component design are reviewed. Costs for reactor development and testing are presented. (DCC)

14693 (APEX-353) GE-ANPD ANNUAL PROGRAM REPORT: USAF CONTRACT YEAR 1958, 1959, 1960; USAEC FISCAL YEAR 1958, 1959, 1960. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). 15 Feb 1958. Contract AT(11-1)-171. 137p. Dep. NTIS $9.00.

Declassified 12 Sep 1973.

The development, design, fabrication, and preparation for the all-nuclear flight of the XMA-1 nuclear propulsion reactor are described. Heat transfer tests and component design are reviewed. Costs for reactor development and testing are presented. (DCC)

14694 (APEX-727) A-136 NUCLEAR TURBO-RAM POWER PLANT (INVENTION DISCLOSURES). Part I. Direct Cycle Aerospace Plane. Szekely, T. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). 10 Apr 1961. Contract AT(11-1)-171. 102p. Dep. NTIS $7.25.

Declassified 12 Sep 1973.

A new concept of a nuclear direct-cycle turbo-ram power plant, the A-136, is described. Information is presented on the power plant cycle, arrangement of components, mechanical design, reactor materials, thermal and nuclear design, reactor kinetics and controls design, shield design, and estimated preliminary performance. The cycle of the A-136 is designed to exploit the high-temperature capabilities of promising new reactor materials without increasing the temperature demands for turbine operation. The cycle and high-temperature reactor are mutually employed to broaden the all-nuclear atmospheric flight spectrum. Also, the A-136 is the first effort to develop for direct cycle atmospheric propulsion a reactor that may be used for ram-rocket propulsion in more advanced nuclear spaceplane systems. (auth)

14695 (APEX-910) AIRCRAFT NUCLEAR PROPULSION APPLICATION STUDIES. Comprehensive Technical Report, General Electric Direct-Air-Cycle, Aircraft Nuclear Propulsion Program. Comassar, S. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). 30 Apr 1962. Contract AT(11-1)-171. 154p. Dep. NTIS $9.75.

Declassified 12 Sep 1973.

Summaries of advanced application studies of nuclear power plants performed by the Aircraft Nuclear Propulsion Department of the General Electric Company are presented. Subsonic aircraft applications studies are described. Both existing and parametric or "paper" aircraft are investigated. Turbojets, turbofans, and turboprops are considered, utilizing direct-air, indirect-liquid-metal, and liquid-circulating-fuel cycles. Studies of supersonic aircraft powered by direct-air-cycle turbojet engines are presented. Both high-speed, high-altitude systems and the hunter/killer mission are investigated. Nuclear ramjet, turbojet, and rocket missile applications are discussed. A study of the feasibility of applying nuclear turbojet power plants to the "Snark" missile is included. The nuclear ICBM application is reported here because its mission places it more logically in the missile than in the rocket category. The nuclear rocket applications include work done in 1956 on heat-transfer rockets and more recent studies of the NERVA-Phoebus system. A concept of a gas-fission rocket propulsion system studied in 1956 is also presented. A study on nuclear-powered helicopters, nuclear hydrofoil propulsion, an examination of gas-cooled reactors for portable power plants in accordance with Army requirements, an analysis of helium-cooled, closed-cycle power plants for turbojets, compressor-jets, and turboprops, and a study of nuclear turboprop airship application are included. Several of the land, sea, undersea, and space applications of the 601 series of power plants are discussed. These are compact, integral, neon-cooled, closed-cycle, fast-reactor power plants that illustrate the strides made in gas-cooled nuclear reactor technology from the beginning to the end of the ANP program. A concept of aerospace nuclear propulsion is described that would permit flight from the Earth to Mars, inspection of that planet, and return, by re-entry, to Earth. The basic concept for this mission is the utilization of a single nuclear system that operates as a turbojet in dense atmospheres, as a ramjet in rarified atmospheres, and as a pure rocket in the vacuum of space. (auth)

14696 (APEX-919) AEROTHERMODYNAMICS. Comprehensive Technical Report, General Electric Direct-Air-Cycle, Aircraft Nuclear Propulsion Program. Noyes, R. N. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). 6 Dec 1961. Contract AT(11-1)-171. 107p. Dep. NTIS $7.50.

Declassified 12 Sep 1973.

The methods and techniques developed for use in the thermal design of nuclear aircraft propulsion reactors are presented. Information and references are given on the analytical and experimental work required to design and evaluate the proposed high performance air cooled fuel elements. Methods of optimizing the thermal designs, particularly by the use of high speed electronic digital computing equipment, are discussed. The computer programs developed to provide accurate performance predictions are identified and described. Means for matching the coolant-flow to the predicted internal heat generation rates in the non-fueled components are discussed. Test methods and results are indicated and significant equipment and instrumentation information provided. The relationships of reactor pressure losses and of localized perturbances to power plant performance are indicated, and the detailed analyses which were required to identify and predict these effects are discussed. (auth)

14697 (DC-60-5-71) REACTOR MECHANICAL DESIGN, ADVANCED CONFIGURATION STUDY. Feathers, L. A. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). 12 May 1960. Contract AT(11-1)-171. 134p. Dep. NTIS $8.75.

Declassified 13 Sep 1973.

The mechanical designs of those reactors considered in the Advanced Configuration Study are presented. The ceramic reactor proposed for the P140 power plant is discussed in detail and the characteristics and dimensions are also presented for reactors, both ceramic and metallic, for the alternate power plants. (auth)

14698 (GA-5226) THERMIONIC SPACE POWER REACTOR SYSTEM RESEARCH AND DEVELOPMENT. Annual Summary Report for the Period Ending April 30, 1964. (General Dynamics Corp., San Diego, Calif. (USA). General Atomic Div.). 15 May 1964. Contract AT(04-3)-167. 70p. Dep. NTIS $5.50.

Declassified 5 Jun 1973.

Information on the development of a thermionic space power reactor system is presented concerning design parameters for the Mark 4 in-pile test assembly, fabrication and construction proce-

dures for Mark 4 cells, testing program for Mark 4 cells, and thermionic reactor kinetics. 10 references. (DCC)

14699 (GA-6107) NEUTRONIC ASPECTS OF THE THERMIONIC REACTOR EXPERIMENT. Shanstrom, R. T.; Russell, J. L.; Broido, J. H.; Drake, M. K.; Goodjohn, A. J.; Hackney, M. R. (General Dynamics Corp., San Diego, Calif. (USA). General Atomic Div.). 15 Mar 1965. Contract AT(04-3)-167. 99p. Dep. NTIS $7.00.

Declassified 5 Jun 1973.

The reactor proposed for this experiment is a small, liquid metal cooled, fast reactor with a thermal power of approximately 500 kW and an electrical output of 50 kW. A model of this reactor and its principal configuration aspects, such as the fueled thermionic diodes (five layers with 36 cells per layer) that form the core, the beryllia reflector, the control drums, and the coolant calandrias are shown. The core diameter is approximately 9 in. and the overall reactor diameter is 18 in. During the past few months, preliminary design type reactor calculations and some experiments on the determination of fast neutron spectra in representative materials have been performed at General Atomic. This analytical and experimental work is summarized. During the progress of the work, there was a gradual refinement in the specifications for some of the basic materials and component parts of the reactor. The calculations were actually performed, therefore, on three different reference designs which were progressively more refined in detail. Most of the parameter work is, however, equally applicable to any one of these designs, i.e., representative of this class and size of reactor in general. The experimental work, which was performed using the General Atomic Linear Accelerator as a means of providing a neutron source, is summarized. The analytical tools and the cross section data that have been used in the work are discussed. It is apparent from both the analytical work on the reactor design itself and the attempts to verify some of the experimental work that more refinements are required in the basic analytical methods and probably also in the cross section data. The proposed future program of analysis, methods development, subcritical and critical assembly measurements, and pulsed neutron work with the linear accelerator are described. 29 references. (auth)

14700 (GA-6504) PRELIMINARY STUDY OF THE STABILITY CHARACTERISTICS OF A FAST-SPECTRUM THERMIONIC REACTOR. Baxter, A. M.; Shanstrom, R. T. (General Dynamics Corp., San Diego, Calif. (USA). General Atomic Div.). 14 Oct 1965. Contract AT(04-3)-167. 31p. Dep. NTIS $3.75.

Declassified 5 Jun 1973.

Results from an initial dynamic analysis of a small, fast-spectrum thermionic reactor are presented. The stability of the system against small perturbations from the equilibrium state is analyzed. While at this stage the reactor design is too preliminary to justify a detailed stability analysis of the entire system (including the control system and all other significant reactivity feedback mechanisms), useful design information can be obtained from an investigation of the more important and prompt-acting feedback parameters. The role of the Doppler coefficients in the thermionic reactor is analyzed. The investigation was stimulated by the observation that negative Doppler coefficients would be obtained from the materials utilized for the thermionic emitter and collector, since they are strong resonance absorbers, and furthermore that the response time of these components could be expected to be relatively prompt. Since accurate calculations were not yet available for Doppler coefficients, this stability study was carried out on a parametric basis, and the principal result of the work is a map of the regions of inherent stability or instability of the core as functions of the magnitudes of the Doppler coefficients of fuel, emitter, and collector. In view of the preliminary nature of the study and the time limits imposed on it, the calculational model was appropriately simplified. In particular, a single thermionic diode was considered, with lumped neutron kinetics, averaging of temperatures in each material region, such as fuel, emitter, cladding, etc., and linearization of the time dependence of the state variables. The principal conclusions drawn from this model are as follows: the Doppler coefficient of the collector is of less importance for reactor stability than that of the emitter. A negative emitter coefficient can yield a stable system even with a positive fuel Doppler coefficient if the negative emitter coefficient is one to two orders of magnitude higher than the positive fuel coefficient. For example, if the fuel Doppler coefficient were found to be $+10^{-5}$, an emitter coefficient of -0.5 to -1.0×10^{-4} would be required for stability. As expected, the reactor is stable for negative fuel Doppler coefficients. 9 references. (auth)

14701 (GA-8977) FLIGHT DYNAMIC TESTING AND ANALYSIS OF THERMIONIC REACTOR FUEL ELEMENTS. Allen, D. T. (Gulf General Atomic Co., San Diego, Calif. (USA)). 30 Nov 1968. Contract AT(04-3)-167. 70p. Dep. NTIS $5.50.

Declassified 5 Jun 1973.

This mechanical analysis of a thermionic reactor fuel element has two objectives. The first is to determine by theory and experiment what resonances exist in the fuel element design, and to correlate the theoretical and experimental results so as to know the confidence in future theoretical analysis. The second is to subject a fuel element to the environment specified for the qualification of flight reactor components. The response of the Mark VIIB fuel element to varying infrequency at several loads is presented. It is believed that of the resonances seen none is the vibrations of the emitter as a cantilever. Some resonances do appear and have not been identified as to source. The fuel element failed to qualify in this test. The emitter failed in the stem region below the diffusion bond in the next to last test of the series. An improperly designed fuel holddown device is the probable cause of the failure. However, the insulator seal, closure braze, fuel and alignment device qualify up to the last test performed. A second fuel element test is under way and specifications for the second test are appended to the report. (auth)

14702 (GA-8981) LOW-POWER REACTOR COMPARISONS. Homeyer, W. G. (Gulf General Atomic Co., San Diego, Calif. (USA)). 21 Feb 1969. Contract AT(04-3)-167. 53p. Dep. NTIS $4.75.

Declassified 5 Jun 1973.

Studies were made of a number of low power (<300 kW(e)) thermionic reactors containing flashlight or unit cell thermionic fuel elements. The objective of these studies was to determine the feasibility of producing a net power of 50 to 100 kW(e) with a power plant weighing 3000 to 4000 lb (1360 to 1820 kg). Reactors fueled with U-233 were shown to be the only alternative meeting the performance goal. For U-235 fuel, reactors containing UN driver elements were shown to produce the lightest power plants at power levels below 100 kW(e). The use of U-ZrH instead of UN driver elements increased power plant weight. Above 100 kW(e), the turned-down minimum critical reactor without driver elements was shown to provide the lightest power plant. 17 references. (auth)

14703 (GA-9509) COMPARISON OF THERMIONIC REACTOR CONCEPTS FOR 50 TO 100 kWe. Cohen, S. C.; Fisher, C. R.; Hackney, M. R.; Heath, C. A.; Homeyer, W. G. (Gulf General Atomic Co., San Diego, Calif. (USA)). Oct 1969. Contract AT(04-3)-167. 141p. Dep. NTIS $9.25.

Five thermionic reactor types were studied for use in the power range of 50 to 100 kW(e). These were (1) an all-cell U-235 reactor which is larger than necessary and turned down to 100 kW(e), (2) an all-cell U-233 reactor, (3) a reactor with ^{233}UN driver elements in addition to thermionic fuel elements, (4) a reactor with ^{233}U-ZrH driver elements and the same Mark VIIB thermionic elements (1.1 in. diameter by 2 in. long emitter) used in the fast reactors, and (5) a reactor with U-ZrH driver elements and Mark VIIA thermionic elements (0.63 in. diameter by 2 in. long emitter). Performance comparisons in terms of power plant weight showed that the all-cell U-233 reactor was by far the best, while the all-cell U-235, UN driver, and Mark VIIB U-ZrH reactors all have similar intermediate performance, and the Mark VIIA U-ZrH reactor has the poorest performance. The Mark VIIA U-ZrH driver reactor was also difficult to control with poison-backed reflector drums and was found to require several modifications including a large increase in the diameter of the control drums to obtain adequate control. A comparison of the dynamic behavior of the UN driver reactor with that of the U-235 all-cell reactor showed that the prompt negative reactivity coefficient due to expansion of the driver elements could prevent rupture of the thermionic fuel element cladding for accidental rates of reactivity insertion of $5 to $20 per second. 5 references. (auth)

14704 (GA-9510) DEVELOPMENT OF A THERMIONIC REACTOR SPACE POWER SYSTEM. Summary Report for Period March 1, 1969-June 30, 1969. (Gulf General Atomic Co., San Diego, Calif. (USA)). 11 Jul 1969. Contract AT(04-3)-167. 143p. Dep. NTIS $9.25.

Research progress made during the period is reported under the following headings: materials technology; converter technology; converter testing; reactor technology; reactor experiment; and system technology. (JWR)

14705 (N-73-25722) EVOLUTIONARY APPROACH FOR A COMPACT-SPLIT-CORE REACTOR. Breitwieser, R.; Lantz, E. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). 1973. 28p. (NASA-TM-X-68254; E-7533). NTIS $3.50.

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (11 Jun 1973).

An economical approach for advanced reactor power development is presented, and systems that result from the several stages of this plan are described. The development starts with a highly modularized heat pipe, radioisotopic design and evolves into a low specific weight high performance reactor system. (auth)

14706 (N-73-25725) PILOT-LEVEL DECISION ANALYSIS OF THERMIONIC REACTOR DEVELOPMENT STRATEGY FOR NUCLEAR ELECTRIC PROPULSION. Final Report. Menke, M. M.; Judd, B. R. (Stanford Research Inst., Menlo Park, Calif. (USA)). May 1973. Contract NAS7-100. 113p. (NASA-CR-133035). NTIS $7.75.

For Jet Propulsion Lab., Pasadena, CA.

The development policy for thermionic reactors to provide electric propulsion and power for space exploration was analyzed to develop a logical procedure for selecting development alternatives that reflect the technical feasibility, JPL/NASA project objectives, and the economic environment of the project. The partial evolution of a decision model from the underlying philosophy of decision analysis to deterministic pilot phase is presented, and the general manner in which this decision model can be employed to examine propulsion development alternatives is illustrated. (auth)

14707 (N-73-26671) PRELIMINARY NUCLEAR ELECTRIC PROPULSION (NEP) RELIABILITY STUDY. Hsieh, T. M.; Nakashima, A. M.; Mondt, J. F. (Jet Propulsion Lab., Pasadena, Calif. (USA)). 1 Jul 1973. Contract NAS7-100. 22p. (NASA-CR-133233; JPL-TM-33-629). NTIS $3.25.

A preliminary failure mode, failure effect, and criticality analysis of the major subsystems of nuclear electric propulsion is presented. Simplified reliability block diagrams are also given. A computer program was used to calculate the reliability of the heat rejection subsystem. (auth)

14708 (N-73-26673) INSTABILITIES IN FISSIONING PLASMAS AS APPLIED TO THE GAS-CORE NUCLEAR ROCKET ENGINE. Final Report. (Versar, Inv., Springfield, Va. (USA)). 3 Jun 1973. Contract NASw-2378. 48p. (NASA-CR-133235). NTIS $4.50.

The compressional wave spectrum excited in a fissioning uranium plasma confined in a cavity such as a gas cored nuclear reactor, is studied. Computer results are presented that solve the fluid equations for this problem including the effects of spatial gradients, nonlinearities, and neutron density gradients in the reactor. Typically the asymptotic fluctuation level for the plasma pressure is of order 1 percent. (auth)

14709 (N-73-27585) CONCEPTUAL DESIGN AND THERMAL ANALYSIS OF THE EXHAUST DUCT FOR A FISSIONING URANIUM PLASMA TEST REACTOR. Putre, H. A. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Aug 1973. 21p. (NASA-TM-X-2861; E-7457). NTIS.

The conceptual design and analysis of a film cooled exhaust duct for a gas core rocket test cavity is described. The cavity exhaust has a temperature of 4000°K and 200 atmospheres of pressure. The film cooled duct design uses seeded hydrogen coolant flow to reduce the duct outlet temperature to 850°K, and the maximum duct wall temperature to below 700°K. With this design less than 1 percent of the uranium fuel flow rate in the exhaust plates out on the duct walls. (auth)

14710 (N-73-27586) COMPUTER OPTIMIZATION OF REACTOR THERMOELECTRIC SPACE POWER SYSTEMS. Maag, W. L.; Finnegan, P. M.; Fishbach, L. H. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Aug 1973. 17p. (NASA-TM-X-2860; E-7446). NTIS $3.00.

A computer simulation and optimization code that has been developed for nuclear space power systems is described. The results of using this code to analyze two reactor-thermoelectric systems are presented. (auth)

14711 (N-73-28653) SATELLITE NUCLEAR POWER STATION: AN ENGINEERING ANALYSIS. (Georgia Inst. of Tech., Atlanta (USA)). Mar 1973. 147p. (NASA-CR-121254). NTIS $9.50.

The satellite nuclear power station (SNPS), remotely operated in synchronous orbit, is discussed, transmitting power safely to the ground by a microwave beam. Fuel reprocessing would take place in space and no radioactive materials would be returned to earth. (STAR)

14712 (N-73-28653, pp 3-22) INTRODUCTION. Williams, J. R. Mar 1973. (N-73-28654).

In satellite nuclear power station: an engineering analysis.

Objections to nuclear power are enumerated. Four potential types of reactors are proposed for using a closed cycle nuclear MHD system. These reactors include a NERVA-type solid core reactor, the colloid core reactor, the light bulb gas core reactor, and the coaxial flow gas core reactor. Three different types of closed cycle nuclear MHD power plant systems are analyzed to determine the operating characteristics, critical parameters, and performance. Each power plant's three component subsystems are also described, including: the high temperature reactor with attached MHD generator and uranium separator, the compressor system, and the heat rejection system. (STAR)

14713 (N-73-28653, pp 23-28) MHD GENERATOR PERFORMANCE LIMITATIONS. Rosa, R. J. Mar 1973. (N-73-28655).

In satellite nuclear power station: an engineering analysis.

The electrical properties of the gas are the primary limiting factor to MHD generator performance; the most relevant electrical properties are the conductivity and the Hall parameter. The maximum allowable pressure at several given levels of power extraction vs. temperature is represented graphically. (STAR)

14714 (N-73-28653, pp 29-61) NUCLEAR ANALYSIS. Clement, J. D.; Kirby, K. D. Mar 1973. (N-73-28656).

In satellite nuclear power station: an engineering analysis.

Exploratory calculations were performed for several gas core breeder reactor configurations. The computational method involved the use of the MACH-1 one dimensional diffusion theory code and the THERMOS integral transport theory code for thermal cross sections. Computations were performed to analyze thermal breeder concepts and nonbreeder concepts. Analysis of breeders was restricted to the (U-233)-Th breeding cycle, and computations were performed to examine a range of parameters. These parameters include U-233 to hydrogen atom ratio in the gaseous cavity, carbon to thorium atom ratio in the breeding blanket, cavity size, and blanket size. (auth

14715 (N-73-28653, pp 63-118) POWER PLANT SYSTEMS ANALYSIS. Williams, J. R.; Yang, Y. Y. Mar 1973.

In satellite nuclear power station: an engineering analysis.

Three basic thermodynamic cycles of advanced nuclear MHD power plant systems are studied. The effect of reactor exit temperature and space radiator temperature on the overall thermal efficiency of a regenerative turbine compressor power plant system is shown. The effect of MHD pressure ratio on plant efficiency is also described, along with the dependence of MHD power output, compressor power requirement, turbine power output, mass flow rate of hydrogen, and overall plant efficiency on the reactor exit temperature for a specific configuration. (auth)

14716 (N-73-28653, pp 119-139) COSTS AND APPLICATIONS. Williams, J. R. Mar 1973. (N-73-28658).

In satellite nuclear power station: an engineering analysis.

Assuming an emissivity of 0.9, the total area required for SNPS radiators was calculated. An SNPS producing 13,000 MW of electrical power at an overall thermal efficiency of 56% would reject about 10,000 MW of heat. If the radiator has a length three times its width, then the width of the radiator base may be calculated as a function of radiator temperature. There are two such radiators used with the power plant. The base of a 750°K radiator for a 13,000 MW(e) SNPS would measure 200 meters, and its length would be 600 meters. At 1000°K, these dimensions are cut almost in half. (auth)

14717 (N-73-28662) NUCLEAR CHARACTERISTICS OF A FISSIONING URANIUM PLASMA TEST REACTOR WITH LIGHT-WATER COOLING. Whitmarsh, C. L. Jr. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Aug 1973. 20p. (NASA-TM-X-2864; E-7455). NTIS $3.00.

An analytical study was performed to determine a design configuration for a cavity test reactor. Test section criteria were that an average flux of 10 to the 15th power neutrons/sq cm/sec (E less than or equal to 0.12 eV) be supplied to a 61-cm-diameter spherical cavity at 200-atm pressure. Design objectives were to minimize required driver power, to use existing fuel-element technology, and to obtain fuel-element life of 10 to 100 full-power hours. Parameter calculations were made on moderator region size and material, driver fuel arrangement, control system, and structure in order to determine a feasible configuration. Although not optimized, a configuration was selected which would meet design criteria. The driver fuel region was a cylindrical annular region, one element thick, of 33 MTR-type H_2O-cooled elements (Al-U fuel plate configuration), each 101 cm long. The region between the spherical test cavity and the cylindrical driver fuel region was Be (10 vol.% H_2O coolant) with a midplane dimension of 8 cm. Exterior to the driver fuel, the 25-cm-thick cylindrical and axial reflectors were also Be with 10 vol.% H_2O coolant. The entire reactor was contained in a 10-cm-thick steel pressure vessel, and the 200-atm cavity pressure was equalized throughout

the driver reactor. Fuel-element life was 50 hr at the required driver power of 200 MW. Reactor control would be achieved with rotating poison drums located in the cylindrical reflector region. A control range of about 18 percent delta k/k was required for reactor operation. (auth)

14718 (N-73-28663) CALCULATED POWER DISTRIBUTION OF A THERMIONIC, BERYLLIUM OXIDE REFLECTED, FAST-SPECTRUM REACTOR. Mayo, W.; Lantz, E. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Aug 1973. 17p. (NASA-TM-X-2838; E-7443). NTIS $3.00.

A procedure is developed and used to calculate the detailed power distribution in the fuel elements next to a beryllium oxide reflector of a fast-spectrum, thermionic reactor. The results of the calculations show that, although the average power density in these outer fuel elements is not far from the core average, the power density at the very edge of the fuel closest to the beryllium oxide is about 1.8 times the core average. (auth)

14719 (N-73-29716) PRELIMINARY ANALYSIS OF HOT SPOT FACTORS IN AN ADVANCED REACTOR FOR SPACE ELECTRIC POWER SYSTEMS. Lustig, P. H.; Holms, A. G.; Davison, H. W. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Apr 1973. 38p. (NASA-TM-X-68217). NTIS $4.00.

The maximum fuel pin temperature for nominal operation in an advanced power reactor is 1370°K. Because of possible nitrogen embrittlement of the cladding, fuel temperature was limited to 1622°K. Assuming simultaneous occurrence of the most adverse conditions a deterministic analysis gave a maximum fuel temperature of 1610°K. A statistical analysis, using a synthesized estimate of the standard deviation for the highest fuel pin temperature, showed probabilities of 0.015 of that pin exceeding the temperature limit by the distribution free Chebyshev inequality and virtually nil assuming a normal distribution. The latter assumption gives a 1463°K maximum temperature at 3 standard deviations, the usually assumed cutoff. Further, the distribution and standard deviation of the fuel-clad gap are the most significant contributions to the uncertainty in the fuel temperature. (auth)

14720 (N-73-30508) MATERIALS TECHNOLOGY PROGRAMS IN SUPPORT OF A MERCURY RANKINE SPACE POWER SYSTEM. Stone, P. L. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Sep 1973. 48p. (NASA-TN-D-7355; E-7382). NTIS $3.00.

A large portion of the materials technology is summarized that was generated in support of the development of a mercury-rankine space power system (SNAP-8). The primary areas of investigation are: (1) the compatibility of various construction materials with the liquid metals mercury and NaK, (2) the mechanical properties of unalloyed tantalum, and (3) the development of refractory metal/austenitic stainless steel tubing and transition joints. The primary results, conclusions, and state of technology at the completion of this effort for each of these areas are summarized. Results of possible significance to other applications are highlighted. (auth)

14721 (NP-19907) N. S. SAVANNAH REACTOR SYSTEMS STATUS REPORT. (Maritime Administration, Washington, D. C. (USA)). Dec 1973. 38p.

Information is presented on the status of equipment and systems on the N. S. Savannah which affect the health and safety of the general public. Topics discussed include the status of the reactor plant, declassification as a utilization facility, and calculated residual byproduct material remaining in the system. (JWR)

14722 (NTO-R-141(Vol.3)) NRX-A6 POST TEST REPORT. Volume III. Post-Operative Examination. (NERVA Test Operations, Jackass Flats, Nev. (USA)). Apr 1969. 69p. Dep. NTIS $5.50.

Declassified 29 Aug 1973.

The Disassembly and Post Operational Examination of the NRX-A6 Reactor began on December 20, 1967. Observations, data and photographs and the more obvious general findings are included to present a general report on the NTO Post Test Examination operations and the general condition of the Test Article components. Information concerning the detailed studies of the Post Test Data will be supplied by the cognizant NRO and WANL organizations. Component examinations and the metallography examinations are included. (auth)

14723 (XDC-57-7-59) POTENTIALITIES OF THE NUCLEAR-POWERED TURBOPROP. Schmill, W. C.; Fogg, R. G. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). Jul 1957. Contract AT(11-1)-171. 92p. Dep. NTIS $6.75.

Declassified 13 Sep 1973.

The use of propulsion reactors for large subsonic turboprop aircraft is discussed. The military applications for the nuclear turboprop-powered aircraft are analyzed. Design parameters for the nuclear reactor and turboprop propulsion system are presented. (6 references) (DCC)

14724 (XDC-61-1-17) PRELIMINARY ENGINEERING DESCRIPTION AND PRELIMINARY SPECIFICATIONS OF XNJ140E-1 (ADVANCED CORE TEST) (FINAL ISSUE). (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). 15 Feb 1961. Contract AT(11-1)-171. 235p. Dep. NTIS $13.75.

Declassified 20 Sep 1973.

A preliminary engineering description and preliminary specifications for the XNJ140E-1 engine to be operated as the Advanced Core Test at the Idaho Test Station are presented. The Advanced Core Test program is a test of a prototype of the direct-air-cycle nuclear turbojet engines being developed by the General Electric Company Aircraft Nuclear Propulsion Department. The XNJ140E-1 engine contains an advanced ceramic reactor and utilizes X211-E1 turbomachinery arranged in an integral in-line configuration. The XNJ140E-1 engine is being designed in accordance with parameters established for an objective power plant meeting current Department of Defense nuclear-flight guidance. (auth)

14725 (XDCL-60-12-126) COMPARISON OF DIRECT- AND INDIRECT-CYCLE NUCLEAR TURBOJET ENGINES. Newton, G. W. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). [Dec 1960]. Contract AT(11-1)-171. 63p. Dep. NTIS $5.25.

Declassified 20 Sep 1973.

Current information on the direct-cycle nuclear turbojet power plant is compared with available information on the indirect-cycle power plant. Both cycles have predicted operational thrust-to-weight performance sufficient to equal that specified by Department of Defense guidance. They have promise of development to advanced versions that could power a modification of the B-70 airplane. The direct cycle is considered more reliable, more feasible, and safer than the indirect cycle. It is closer to useful application by several years. (auth)

14726 EXPERIENCE WITH THE NS OTTO HAHN. Ulken, D. (1973). vp. (In German).

From first international meeting on nuclear law: Nuclear Inter Jura 73; Karlsruhe, Ger. (11 Sep 1973).

The good operational experiences up to present are outlined. Furthermore, the paper discusses the time-consuming procedure of negotiating bilateral agreements relating to the safety of nuclear ships and the liability problems associated with the ships' making ports in foreign harbors. (GE)

14727 PARTICLE DENSITY CONTROL SYSTEM FOR COLLOID CORE NUCLEAR REACTOR. Turman, B. N. (to Secretary of the Air Force). U. S. Patent 3,724,484. 3 Apr 1973. Filed Date 13 Jul 1971. 4p.

A control system is provided in the fuel charging system for a colloid core reactor to control the particle density in the fuel input to the reactor cavity. A sound transmitter is positioned on one side of a tubular member in the fuel input, and a microphone is located on the opposite side of the tubular member. A signal, proportional to changes in phase resulting from changes in the acoustics in the tubular member, is used to control the gas flow in a bypass to a cyclone separator fuel supply to control the particle density in the input to the reactor cavity. (Official Gazette.)

Reactor Safety and Environmental Aspects

Refer also to abstracts 12691, 12696, 12751, 12753, 13043, 13074, 14882, and 14935.

14728 (AECL-4513) POST-DRYOUT HEAT TRANSFER AT REACTOR OPERATING CONDITIONS. Groeneveld, D. C. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Jun 1973. 32p. (CONF-730304-15). Dep. NTIS (U. S. Sales Only) $3.75.

From national topical meeting on water reactor safety; Salt Lake City, Utah, USA (26 Mar 1973).

Post-dryout heat transfer data from various laboratories were analyzed. Most data were obtained in directly heated tubes and annuli; an empirical heat transfer correlation was derived for these geometries. A semi-theoretical prediction method was found to agree with the tube data and the correlation. It was not found possible to derive a post-dryout correlation based on available bundle data (which included data from four in-reactor experiments). The bundle data were compared with predictions from the empiri-

cal correlation (based on tube and annuli data); agreement was best at axial locations in the bundle where most of the rods were in dryout. Post-dryout experiments on roughened heaters showed that small roughness elements can reduce post-dryout temperatures considerably. In the annular flow regime this could be accompanied by a reduction in critical heat flux. 102 references. (auth)

14729 (BAW-10040) REACTOR COOLANT PUMP ASSEMBLY OVERSPEED ANALYSIS. Bloomfield, W. L.; Palme, H. S.; Cudlin, J. J.; Dunn, B. M.; Earle, R. W. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). Dec 1973. 121p.

Babcock & Wilcox has analyzed the reactor coolant pump assembly action resulting from postulated reactor coolant system breaks. The homologous pump model used for the speed calculations is described. Results for the spectrum of breaks analyzed are presented. A discussion of the linear elastic fracture analysis to determine the structural failure speed of the reactor coolant pump motor flywheel assembly is included. Test programs and analyses planned and in progress and criteria and test programs now utilized by B & W are described. 5 references. (auth)

14730 (BAW-10074) MULTINODE ANALYSIS OF SMALL BREAKS FOR B AND W'S 205-FUEL-ASSEMBLY NUCLEAR PLANTS WITH INTERNALS VENT VALVES. Jones, R. C.; Dunn, B. M.; Parks, C. E. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). Nov 1973. 54p.

Multinode analyses were conducted for several small breaks in the reactor coolant system of B&W's 205-fuel-assembly nuclear plants with internals vent valves. The multinode blowdown code CRAFT was used to evaluate the hydrodynamics and transient water inventories of the reactor coolant system. The FOAM code was used to compute a swell level history for the core, and the THETA1-B code was used to perform transient fuel pin thermal calculations. Curves showing the parameters of interest are presented. These results are well within the Atomic Energy Commission's Interim Acceptance Criteria. (auth)

14731 (BAW-10075) MULTINODE ANALYSIS OF SMALL BREAKS FOR B AND W'S 177-FUEL-ASSEMBLY NUCLEAR PLANTS WITH RAISED LOOP ARRANGEMENT AND INTERNALS VENT VALVES. Cartin, L. R.; Hill, J. M.; Parks, C. E. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). Dec 1973. 42p.

Multinode analyses were conducted for several small breaks in the reactor coolant system of B&W's 177-fuel-assembly nuclear plants with a raised loop arrangement and internals vent valves. The multinode blowdown code CRAFT was used to evaluate the hydrodynamics and transient water inventories of the reactor coolant system. The FOAM code was used to compute a swell level history for the core, and THETA1-B was used to perform transient fuel pin thermal calculations. Curves showing parameters of interest are presented. The results of these analyses are acceptable within the guidelines set forth in the Atomic Energy Commission's Interim Acceptance Criteria. (auth)

14732 (CEA-CONF-2347) ANALYSIS OF THE COSTS AND OF THE ADVANTAGES AND RELATION BETWEEN THE COST AND THE EFFICIENCY OF CONTROL SYSTEMS. Jammet, H.; Mechali, D.; Lacourly, G. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). [nd]. 17p. (In French). (CONF-730462-1). Dep. NTIS (U. S. Sales Only) $3.00.

In order to decide if a reduction of the exposure from the release of radioactive materials by nuclear installations is possible, a cost-benefit analysis was made. The results showed that the differential analysis of the costs and advantages is a possible approach to the problem of maintaining the public exposure at a level as low as possible. This analysis implies the necessity of adopting for the evaluation of the two terms of the balance a common unity. The monetary expression of the radioactive risks is equivalent to treating in money the cost of human life and all the values attached to it, including imponderable factors such as the psychological. The example treated shows that in the case of a pressurized water reactor the measures proposed to eliminate almost completely the risks for the public assume an implicit price for human life higher than all known evaluations and this in spite of hypotheses which contribute to a sure overestimation of the risks. In spite of its imperfections and its limitations, such an analysis permits a useful comparison with the risks associated with the production of energy from other sources. (tr-auth)

14733 (EURFNR-1102) ASSESSMENT OF COMMERCIALLY AVAILABLE FINITE ELEMENT CODES FOR THE DYNAMIC ANALYSIS OF STRUCTURES. Zehlein, H. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Reaktorentwicklung). Apr 1973. 88p. (KFK-1791). Dep. NTIS $6.50.

Work performed under United States–Euratom Fast Reactor Exchange Program.

The theory of the finite-element-method is sketched and a short introduction to the theory of dynamic analysis of discrete systems is presented. A description of the architecture and capabilities of important, commercially available computer codes for the static and dynamic analysis of structures is given. A distinction is made between General Purpose Program Systems (GPPS) and Special Purpose Program Systems (SPPS), following proper criteria. The 3 most popular GPPS-representatives (STRUDL-II, ASKA, NASTRAN) are explained by direct comparison. Some special purpose systems with outstanding capabilities which have not yet been assimilated by current GPPS's deserve attention as special tools or forerunners for future developments. The information drawn from 21 different codes leads to conclusions regarding the suitability of these programs for application to actual problems of Nuclear Reactor Safety: None of the existing Codes possesses the capability for computing large elasto-plastic deformations under dynamic loading to be met within reactor accidents. (auth)

14734 (FIND-50321) FIND: EDWIN I. HATCH NUCLEAR PLANT, UNIT 1. Items 1-93. Horn, F. H. (ed.). (USAEC Technical Information Center, Oak Ridge, Tenn.). Nov 1973. 36p. Dep. NTIS $4.00.

An index to microfiche issuances of safety analysis reports is provided. Subject citations are to specific frames on the microfiche. (JWR)

14735 (HEDL-TME-73-5(Vol.2)) HEDL QUARTERLY TECHNICAL REPORT, JULY–SEPTEMBER 1973. Volume 2. Reactor and Safety Engineering. Grace, J. N. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Oct 1973. Contract AT(45-1)-2170. 152p. AT.

Safety analysis for the FTR hypothetical core disruption accident is presented. Research programs on the FTR are reviewed concerning nuclear physics, PuO_2–UO_2 fuel design, ZPR-9 mockup experimental program, and FTR shielding. (DCC)

14736 (MRR-127) SWING-R: A DIGITAL COMPUTER PROGRAM FOR CALCULATING THE TIME HISTORY OF THE MOTION OF MULTI-DEGREE-OF-FREEDOM SYSTEMS CONSIDERING NONLINEARITY AND SOLID-STATE FRICTION. Oesterle, B. (Technische Univ. Munich, Garching (F.R. Germany). Lab. fuer Reaktorregelung und Anlagensicherung). Jul 1973. 60p. (In German). Dep. NTIS (U. S. Sales Only) $5.00.

The computer code SWING-R calculates the time history of the space-coordinates, velocities and accelerations of multi-degree-of-freedom systems up to 10° of freedom. It is possible to consider: (1) any number of couplings between the masses (springs, dashpots), (2) any exciting force (periodic, nonperiodic), (3) nonlinear (stepwise linear) springs, and (4) friction between pairs of masses (consideration of static and kinetic friction). The theory of the program is presented. A more detailed description and the use of the program will be given in a separate MRR-P paper. (GE)

14737 (NP-19910) RADIOACTIVE EFFLUENTS FROM NUCLEAR POWER STATIONS IN THE COMMUNITY. Discharge Data Radiological Aspects. (Commission of the European Communities, Luxembourg. Directorate for Health and Safety). Nov 1972. 38p. Dep. NTIS (U. S. Sales Only) $4.00.

Literature data are assembled for 1969, 1970, 1971 on radioactive waste discharges from the nuclear power stations in the European Community. In the case of gaseous effluents a distinction is drawn between noble gases, aerosols, and iodine-131, and in the case of liquid effluents between the total activity (excluding tritium) and tritium alone. The discharge data are compared with the discharge limits for the various power stations. In addition, for the liquid effluents the average yearly concentrations reached in the receiving waterbodies are shown, expressed as a percentage of the maximum permissible concentration in drinking water. Based on the actual waste releases, an evaluation is made of the maximum exposure around each plant site and this exposure is compared with the radiological protection standards in force and with the natural radiation background. Finally, for each power station the ratio of activity discharged to energy produced is given. (auth)

14738 (ZJE-120) ACCIDENT AND SAFETY ANALYSIS OF THE KS-150 REACTOR. Hulovec, J. (Skoda, Pizen (Czechoslovakia). Zavod Vystavba Jadernych Elektraren). 1972. 169p. INIS.

The state of art and the development trends of the safety of power reactors in the world are briefly reviewed and the Bohunice KS-150 reactor safety is analyzed. A method of evaluating the reactor safety based on the postulate of the extreme initiating events is proposed and applied, different accident conditions are analyzed in detail, and the probability of their occurrence during the reac-

tor life-time is estimated. An analysis of accident conditions is made using the original mathematical models for the A-1 nuclear power station reactor and its primary circuit. The results obtained can be used in the elaboration of the A-1 nuclear power station operation guidelines. (auth)

14739 DEEP-FREEZE TECHNOLOGY INVADES THE POWER PLANT. Elec. Light Power, E/G Ed.; 54: No. 21, 50-51(Nov 1973).

Two applications of cryogenic techniques in nuclear power plants are described. The first deals with the use of cryogenic systems to remove radioactive components, particularly ^{85}Kr, from nuclear power plant off-gas streams. The second involves the use of liquid nitrogen as a source of inert gas to prevent explosions or fires in an emergency. It is predicted that uses of cryogenic technology in nuclear power plants will increase. (LCL)

14740 SEISMIC EVALUATION OF ELECTRICAL EQUIPMENT FOR NUCLEAR POWER STATIONS. Prause, R. H.; Ahlbeck, D. R. Shock Vib. Bull.; No. 42, 11-20(Jan 1972).

A review of current seismic specifications for electrical equipment and the different types of vibration excitation that might be used to satisfy these specifications led to the design and construction of a seismic vibration facility with the capability of reproducing typical building floor earthquake acceleration time histories. The design of the vibration table and control system and the development of the acceleration time-history command signal are discussed. A comparison of the acceleration response spectra for the table motion and a typical command signal demonstrates the feasibility of using this type of realistic simulation of earthquake motions for evaluating electrical equipment performance. Significant results from this work are included to provide equipment designers with some typical experiences. (App. Mech. Rev.)

14741 INTERNATIONAL RESPONSIBILITY OF STATES FOR THE PEACEFUL USE OF NUCLEAR ENERGY. The Need for International Legislative Action. Zaldivar, E. (Univ. of Buenos Aires). (1973). vp.

From 1st of international meeting on nuclear law: Nuclear Inter Jura 73; Karlsruhe, Ger. (11 Sep 1973).

After a detailed presentation of possible damages, the necessity of the regulation of the liability of states which is neither treated in the Paris nor in the Vienna Convention is emphasized. Reasons are among others that, in most cases, nuclear research is managed by the state itself or under its surveillance and that the amends of damages to be expected exceed private solvency. A stepwise international regulation oriented on urgencies is proposed. (GE)

14742 EMISSION OF RADIOACTIVE LIQUID WASTES FROM NUCLEAR POWER PLANTS. Aurand, K.; Arndt, J.; Ruehle, H.; Wolter, R. (Bundesgesundheitsamt, Berlin). Atomwirt., Atomtech.; 18: No. 11, 529-531(Nov 1973). (In German).

The Federal Public Department, together with the utilities, developed a method including all liquid waste sampling of all operating power plants in the FRG by analyzing the wastes with respect to quality and quantity of the different radionuclides. The results are evaluated by a special computer program (AUGAS), so that a balance of all radionuclides in these wastes is possible at any time. Thus estimates of a possible radiation dose to the population are more accurate than those obtained by the usual evaluation of the total activity of the liquid wastes. (GE)

14743 PROCESSES OCCURRING IN A FAST REACTOR IN THE CASE OF A COOLING SYSTEM DEFICIENCY. Unger, H. Stuttgart, Ger.; Stuttgart Univ. (1971). 94p. (In German).

The possible energy release by radioactive decay, fission product release reactivity, and the role of delayed neutrons and chemical sodium-molten fuel reactions in the case of an accident are discussed. To prevent melting of the reactor vessel, a core catcher consisting of depleted UO_2 is proposed. (GE)

14744 EXPERIMENTS AND ANALYSIS, BY THE METHOD OF CHARACTERISTICS, ON LOSS OF COOLANT ACCIDENTS. Banerjee, S. (Atomic Energy of Canada Ltd., Pinawa Manitoba); Jeffries, R. B.; Goulding, H.; Jaganathan, T. (1973). vp.

From international meeting on reactor heat transfer; Karlsruhe, Ger. (9 Oct 1973).

An outline of a technique for analysis of LOCAs by the method of characteristics and some comparisons with experiments are presented. Prediction of coolant density in the heated section, pressures, temperatures, and flow rates as functions of time following a pipe rupture are discussed. (GE)

14745 HARMONIZATION OF THE LICENSING CONDITIONS INCLUDING ENVIRONMENTAL PROTECTION FOR THE SITING OF NUCLEAR POWER PLANTS. Castellon Fernandez, E. (Forum Atomico Espanol, Madrid). (1973). vp. (In Spanish).

From 1st international meeting on nuclear law: Nuclear Inter Jura 73; Karlsruhe, Ger. (11 Sep 1973).

The Spanish Atomic Forum dedicated the 1972 lectures to the problem of site selection for nuclear power plants from the technical, environmental, and legal point of view. Justifications for the extensive use of nuclear power in the future are considered in relation to the Nuclear and Radioactive Installations Act of July 21, 1972 and of the Atmospheric Contamination Law of Dec. 22, 1972. The possibility of establishing a national plan for the siting of nuclear power plants in agreement with the national electric power plan, and taking into account the requirements of environmental protection is considered. (GE)

14746 STUDIES FOR ASEISMIC DESIGN OF ATOMIC POWER EQUIPMENT. Ochiai, K. (Hitachi Ltd., Ibaraki, Japan); Kaga, M.; Shiga, M. Hitachi Hyoron; 21: No. 7, 264-270(Jul 1972).

In recent years the need is being stressed for measures to minimize earthquake damage in many industrial fields. Particularly severe conditions must be met in the aseismic design of atomic power stations, for which safety is the prime consideration. Highly advanced procedures are now available for earthquake dynamic response analysis, using computers. Since the structure involved is generally of complex design, numerous experimental studies are required for accurate analyses and for demonstrating the validity of a theory. For more than 10 years now, studies on response analyses for earthquakes have been conducted. Some recent experiments on equipment for BWR-type nuclear power plants are described. (auth)

14747 NONLINEAR DYNAMIC RESPONSE OF A NUCLEAR POWER SYSTEM TO GROUND MOTION. Howard, G. E. Los Angeles; Univ. of California (1973). 149p. University Microfilms Order No. 73-28,965.

Thesis (Ph. D.).

The nonlinear structural response of a nuclear power plant to strong ground motion was investigated using a dynamic model derived from results of structural testing by explosives-generated ground motion. Presented is a structural testing methodology, results of applying test methods to an existing nuclear power facility, and the development of a system model incorporating structural nonlinear effects and soil-structure interaction. The model was subjected to earthquake-like excitation to estimate system response to varying levels of seismic loading. Parameter studies on plausible nonlinear models were conducted, and the sensitivity of nonlinear response evaluated with respect to soil-structure interaction. The results show the sensitivity of critical equipment exhibiting nonlinear dynamic response to both soil-structure interaction and to nonlinearities in the response of a supporting structure. Differences of greater than a factor of three in equipment maximum relative displacement were possible when comparing a linear system model to various nonlinear models. Inclusion of nonlinear damping increasing significantly with response was beneficial, but nonlinear response still exceeded linear model predictions by a factor of two or more at high levels of seismic loading. Increased soil-structure interaction was found to increase equipment maximum displacement relative to equipment supports. The study illustrates the significant non-conservative errors possible when using linear models based upon low amplitude response to predict the high loading response of a non-linear system, particularly a system in which sensitive equipment exhibits highly nonlinear behavior. Shown also is the utility of explosives-generated ground motion in the study of structural dynamic response, and the essential role of experimentation in determining the form and magnitude of significant nonlinear phenomena in an actual, as opposed to nominal or blue-printed, structural system. (Diss. Abstr. Int., B)

14748 NUCLEAR POWER PLANT. pp 163-173 of Energie und Abwaerme: Ursachen, Auswirkungen, Empfehlungen. Beck, P. Berlin; Schmidt (1973). (In German)

Nuclear power plants prevent environmental pollution and consume no oxygen, but they emit heat into the environment. The light-water reactor types dominating the market (pressurized water reactors and boiling water reactors) are compared with one another and with the gas cooled high-temperature reactors, especially with the helium cooled graphite moderated thorium high temperature reactor and with the sodium cooled breeder reactor, mainly from the efficiency and waste heat point of view. The efficiency of the breeder reactor combined with the steam power device reaches 40%. The intense promotion of the gas cooled high temperature reactor is recommended, allowing the use of gas turbines in the direct cycle along with the advantages of higher efficiency, smaller amount of waste heat (by means of closed-circuit cooling), and the development of the gas breeder reactor. (GE)

14749 BIG BLOWDOWN RIGS AT THE GERMAN BATTELLE-INSTITUT. Nucl. Eng. Int.; 18: No. 209, 803-804(Oct 1973).

Experimental work on reactor safety at the Battelle Institut at

Frankfurt is outlined. The two main series of experiments are concerned with the effect of a major rupture of the primary circuit on the internal structure of the reactor and on the containment. A test facility for investigating the internal effect of blowdown is linked to a larger facility for analyzing the expansion of steam and water from a major rupture through the primary circuit into the main containment building. A further program is concerned with acoustic emission from metals under high stress. (UK)

14750 LOVIISAN YDINVOIMALAN VAIKUTUS ILMAN RADIOAKTIIVISUUTEEN JA SAETEILYANNOKSIIN SEKAE NORMAALITOIMINNAN ETTAE HAEIRIOEIDEN AIKANA. (Effect of Loviisa Nuclear Power Station on the Radioactivity of Air and Radiation Doses Under Normal Conditions and Accidents). Haekkinen, H. H. Ilmatieteen Laitoksen Tiedonantoja, No. 25. Helsinki; Finnish Meteorological Institute, Library (1972). 152p. (NP-19743). $9.75.

Eight nuclear plants are to be built along the south coast of Finland in the next ten years. Their total output will be almost 4000 MW. Three pressurized water type (PWR) reactors will be located at Loviisa, on Hästholmen Island, and their total output will be about 1300 MW. Meteorological data are reviewed in relation to the effects of operation of these reactors under normal conditions and in case of major accidents on contamination of the atmosphere. Design features to prevent the discharge of gases from the reactor directly to the atmosphere are discussed. Estimates of the contribution of reactor operations to the radiation dose of human populations are included. (CH)

14751 NUCLEAR SAFETY. Volume 14, No. 6, November–December 1973. Compilation of Nuclear Standards. Part I. United States Activities. Blakely, J. P. A Technical Progress Review Published for the Technical Information Center USAEC. Oak Ridge, TN; Oak Ridge National Laboratory (1973). 152p. GPO $0.60.

Thirteen papers are included. A separate abstract was prepared for each of 12. One paper appeared previously in NSA as abstract No. 28: 18465. (LCL)

For abstracts of individual papers see: 12686, 13280, 14752–14760, and 14829.

14752 NUCLEAR EMERGENCY PLANNING IN THE STATE OF NEW JERSEY. Amato, C. G. Nucl. Safety; 14: No. 6, 563-573(1973).

To meet the necessity for a public-emergency plan for large-scale radiation incidents, the state government of New Jersey has developed PIPAG, Procedures for Implementing Protective Action Guides. PIPAG is a contingency plan based on cooperative, prudent preplanning aimed toward maintaining public confidence and controlling dose and dose commitments. The plan is based on the law, geography, resources, and policies of New Jersey. It maximizes the use of existing resources and relies on the concept of civil-defense organizations as local governments in an emergency. Both the technology and sociology aspects of a reactor accident are considered since PIPAG, if ever implemented, will deal with communities of people. The social concepts of disaster and reactor accidents are introduced, and the factors affecting disasters, as well as protective-action levels, are discussed. (auth)

14753 STATE RESPONSIBILITIES FOR NUCLEAR POWER: LAPP REPORT TO THE ILLINOIS COMMERCE COMMISSION. Nucl. Safety; 14: No. 6, 574-576(1973).

Selected conclusions and recommendations of the Lapp Report on an investigation of two incidents which occurred at the Dresden Nuclear Power Station in 1970 and 1971 are presented. This information was selected as relevant to a state's responsibility for public safety. (LCL)

14754 SITING PRACTICE AND ITS RELATION TO POPULATION. Piper, H. B. (Project Management Corp., Chicago); Heddleson, F. A. Nucl. Safety; 14: No. 6, 576-585(1973).

A study was made to determine the relation between power-reactor sites and the surrounding population in the United States and in some foreign countries. Results show that the population-vs.-distance envelope represented by a combination of the Indian Point and Zion sites has served as an upper boundary in current siting practice. It is also shown that the application of engineered safety features has had no discernible effect on the selection of sites. (auth)

14755 POWER-PLANT SAFETY AND EARTHQUAKES. Smith, C. B. Nucl. Safety; 14: No. 6, 586-596(1973).

The importance of considering seismic effects in the design of power plants for electricity generation, with emphasis on nuclear power plants is stressed. The potential effects on plant performance are described, methods for seismic analysis are reviewed, and the need for seismic instrumentation and testing are discussed. (auth)

14756 COMPARATIVE RELIABILITY ANALYSES OF REACTOR SAFETY SYSTEMS. Howard, R. S.; Schultz, M. A. Nucl. Safety; 14: No. 6, 605-617(1973).

Five reactor protection systems have been analyzed using a Monte Carlo simulation technique to solve for system reliability as a function of test and repair interval. The systems were evaluated for both safety reliability and protection against false scrams. The analysis technique is described in detail, with emphasis on the assumptions made and the validity of the results. A method of scaling the input for the Monte Carlo program by varying the repair interval is developed. The systems analyzed include four commercial reactor protection systems, each designed by a different manufacturer, and a proposed system, suggested at Pennsylvania State University. The reliabilities of the systems are compared by examining system failure probabilities. Considerable differences in performance were found in the various systems, suggesting that still better configurations may yet be obtained. (auth)

14757 SAFETY-DESIGN BASES OF THE HTGR. Wessman, G. L.; Moffette, T. R. (Gulf General Atomic Co., San Diego). Nucl. Safety; 14: No. 6, 618-634(1973).

The high-temperature gas-cooled reactor (HTGR) has inherent and design safety features that are significant and unique, requiring a number of safety criteria and approaches that differ markedly from other reactor types. First, the designs of HTGR plants that have been built and are being offered in the United States are discussed. The safety considerations in the design of the plants now being offered are reviewed. The unique features, their development, and their effects on safety criteria are described, with particular emphasis on the design bases of the prestressed-concrete reactor vessel. (auth)

14758 SIZING OF AIR-CLEANING SYSTEMS FOR ACCESS TO NUCLEAR PLANT SPACES. Estreich, P. J. Nucl. Safety; 14: No. 6, 634-642(1973).

A mathematical basis is developed to provide the practicing engineer with a method for sizing air-cleaning systems for nuclear facilities. In particular, general formulas are provided to relate cleaning and contamination dynamics of an enclosure such that safe conditions are obtained when working crews enter. Included in these considerations is the sizing of an air-cleaning system to provide rapid decontamination of airborne radioactivity. Multiple-nuclide contamination sources, leak rate, direct radiation, contaminant mixing efficiency, filter efficiencies, air-cleaning-system operational modes, and criteria for maximum permissible concentrations are integrated into the procedure. (auth)

14759 RECENT OCCURRENCES AT NUCLEAR REACTORS AND THEIR CAUSES. Castro, W. R. Nucl. Safety; 14: No. 6, 664-668(1973).

Occurrences from May to Sept. 1973 at US power reactors are presented in three tables designated as occurrences after operation began but not during surveillance testing, occurrences during surveillance testing, and occurrences during construction and preoperational testing. The date, cause, and characteristics of each occurrence and the facility at which it occurred are tabulated. (LCL)

14760 SAFETY-RELATED OCCURRENCES REPORTED IN JUNE, JULY, AND AUGUST 1973. Castro, W. R. Nucl. Safety; 14: No. 6, 668-670(1973).

Three incidents of general interest to power reactor operators which occurred during June to Sept. 1973 at US nuclear power plants are discussed. In the first, lightning struck a ventilation stack at the Vermont Yankee plant and disabled a number of monitoring instruments. A safety review concluded that inadequate grounding caused the failures of the electronic systems and recommended corrective actions. In the second, gas-bubble disease killed many menhaden fish in the condenser discharge channel of the Pilgrim power plant. By operating the plant for four days at a reduced power level in order to decrease the intake-to-discharge seawater temperature differential to less than 15°F the gas saturation level was satisfactorily reduced and steps were taken to prevent a recurrence of the fish kill. Finally, an incident is described in which operator inattention to the secondary systems of a PWR caused the Zion 1 plant to shut down as the steam generator water level decreased. (LCL)

14761 NUCLEAR FUEL CYCLE INSURANCE. Dupuis, H. J.; King, W. T. Jr.; Mathers, C. W.; Olding, R. P. (Johnson and Higgins, New York). Nucl. Mater. Manage.; 11: No. 3, 11-17(Fal 1973).

From proceedings of the 14th annual meeting of the Institute of Nuclear Materials Management, Inc.; San Diego, CA (20 Jun 1973).

The development of nuclear insurance policies and programs is reviewed. Required insurance policies and coverages for the complete nuclear fuel cycle are described. (DCC)

Reactor Theory and Calculation

Refer also to abstracts 14114, 14125, 14275, 14307, 14308, 14622, 14623, 14629, 14650, 14676, and 14679.

14762 (AE-480) AXIAL AND TRANSVERSE MOMENTUM BALANCE IN SUBCHANNEL ANALYSIS. Rouhani, S. Z. (Aktiebolaget Atomenergi, Studsvik (Sweden)). 1973. 57p. (CONF-730114-3). Dep. NTIS (U.S. Sales Only) $5.00.

From meeting on requirements and status of the prediction of physics parameters for thermal and fast power reactors; Julich, F. R. Germany (23 Jan 1973).

In the thermo-hydraulic assessment of rod-bundles for thermal or fast reactors, it has become a common practice to apply the method of subchannel analysis. In an attempt to improve the validity and usefulness of subchannel analysis one is led to a review of the formulation of the basic principles for such calculations. The essential aspect of momentum balance in axial and transverse directions is considered. Instead of formulating the momentum balance at once in terms of the average velocities in subchannels, the equations of motion in differential form are used. By some formal integration and normalization procedure, involving the commonly used subchannel definition, a final set of momentum equations in difference form are obtained which are in terms of the average velocities in subchannels. In this manner a different effect of diversion crossflow and an improved form of the transverse momentum equation is obtained. This equation includes the important effect of inertia and also shows the influence of geometry on its magnitude in various cases. Calculated trends of transverse pressure difference obtained with these equations show a far better agreement with experimental data as compared with the ordinary subchannel calculations. (auth)

14763 (AEEW-R-902) WIMS-E MODULE W-BRNUP. Gubbins, M. E.; Sherwin, J. (UKAEA Reactor Group, Winfrith. Atomic Energy Establishment). Nov 1973. 37p. Dep. NTIS (U. S. Sales Only) $4.00.

The burnup module WBRNUP which forms a part of the WIMS-E modular scheme is described. Included are sections on the use of the module in relation to other modules within WIMS-E as well as descriptions of how the module works. A glossary of terms is included. (auth)

14764 (AWRE-O-36-73) DESCRIPTION OF NEW CAPABILITIES OF THE MULTIGROUP NEUTRON TRANSPORT PERTURBATION THEORY PROGRAMS DUNEE, SPECTRE, AND JINX. West, P. H. (UKAEA Weapons Group, Aldermaston, Atomic Weapons Research Establishment). Nov 1973. 44p. Dep. NTIS (U. S. Sales Only) $4.25. UK £1.00.

The neutron transport perturbation theory programs DUNDEE, SPECTRE and JINX calculate respectively the sensitivities of inverse reactivity and time constant, central spectra and central reaction-rate ratios in spherical systems to changes in the group cross section data. These sensitivities are used by the program PENICUIK 3HS in the systematic adjustment of group cross section data to make them consistent with integral measurements. The programs have recently been modified to calculate sensitivities of integral data to changes in temperatures of fission and inelastic spectra. The changes are described along with the mode of operation of the programs on the IBM 370/165. (auth)

14765 (BARC/I-176, pp 1-68) THEORY OF RESONANCE ABSORPTION IN THERMAL AND FAST REACTORS. Huria, H. C. (Bhabha Atomic Research Centre, Bombay). 1972.

Resonance absorption in nuclear reactors is discussed in detail with a few examples to bring out the essential problems. A brief resume of cross-sections in the resonance energy region is given and the resonance parameters for fuel isotopes are determined. Resonance absorption in homogeneous and heterogeneous systems is described. Multiregion techniques are employed for calculations in the latter case. Dependence of resonance integrals on temperature and geometry is discussed. Doppler effects in fast and thermal reactors are compared and the specific problems concerning the Doppler effect in the former are analyzed. The high energy approximation used in the above calculations is mentioned. (INIS)

14766 (BARC/I-176, pp 69-87) NEUTRON THERMALISATION IN REACTORS. Jain, V. K. (Bhabha Atomic Research Centre, Bombay). 1972.

An attempt is made to summarize the various physical ideas used in the field of neutron thermalization. The discussions are restricted to the steady state problems which are of immediate interest to reactor physicists. The study is reported in three parts: (i) a general description of the study and demonstration of its significance with examples; (ii) discussion of the different scattering laws used for moderators of special interest to reactor technologists in India and (iii) discussion of the problems of neutron spectra in finite and infinite media. (INIS)

14767 (BARC/I-176, pp 88-104) VARIATIONAL TECHNIQUES FOR REACTOR CALCULATIONS. Dwivedi, S. R. (Bhabha Atomic Research Centre, Bombay). 1972.

The general mathematical characteristics of variational principles and its application in solving reactor physics problems are reviewed in detail. They have great appeal as the basis of approximate mathematical description of neutron behavior in reactors. The formulation and the derivation of the principle are dealt with in part I, whereas the transport approximation and variational synthesis are discussed in Part II and III, respectively. (INIS)

14768 (BARC/I-176, pp 105-119) TIME-DEPENDENT STUDIES IN REACTOR THEORY. Trasi, M. S. (Bhabha Atomic Research Centre, Bombay). 1972.

Some theoretical studies carried out recently on the time dependent behavior of a reactor are described. The reactor kinetic equations (for a sinusoidal input) by three different methods, viz. (i) the method of quasi-periodic vectors, (ii) the method of idempotent matrices and (iii) the method of second order perturbation of the integro-differential equation are considered. The study of the near linear stability analysis of reactors, both qualitative and quantitative, is reviewed. (INIS)

14769 (BARC/I-176, pp 173-187) CURRENT DEVELOPMENTS IN PHYSICS OF FAST REACTORS. Shankar Singh, R. (Bhabha Atomic Research Centre, Bombay). 1972.

Problems of current interest in the physics of fast reactors are discussed. These include the topics under development from the areas of nuclear data, methods of analysis and integral experiments. Adjustment of nuclear data to fit integral experiments which is being studied in several countries is also briefly discussed. (auth)

14770 (BARC/I-190, pp 2-37) APPLICATION OF LIE SERIES TO REACTOR THEORY. Lawande, S. V. (Bhabha Atomic Research Centre, Bombay). 1972.

Some elementary ideas and the mathematical properties of Lie Series are discussed. The application of Lie Series in obtaining the solutions of ordinary differential equations of the first and the second order is considered. Their wide use for problems in reactor theory, due to the fact that they offer a convenient recourse to problems which are otherwise analytically insoluble, is outlined. The success of Lie Series in obtaining suitable recurrence relations and in computing coefficients has been demonstrated with suitable examples. (INIS)

14771 (BARC/I-190, pp 267-277) COMPUTER CODE SYSTEMS FOR NUCLEAR DESIGN OF REACTORS. Rastogi, B. P. (Bhabha Atomic Research Centre, Bombay). 1972.

The various computer codes that were developed in the Theoretical Physics Division of the Bhabha Atomic Research Centre, for different types of reactors, such as heavy water moderated, light water moderated, and fast reactors are described. The status of these systems, their limitation and degrees of flexibility and their specific uses are mentioned. Nuclear data relating to (a) compilation and evaluation of data and (b) development of multigroup sets and their adjustments on the basis of integral experiments, which are required for these calculations are discussed. (INIS)

14772 (FEI-277) CALCULATING THE FRACTION OF LIQUID FLOWING IN CORE AT DISPERSION-ANNULAR FLOW REGIME. Gorban, I. A.; Kirrilov, P. L. (Gosudarstvennyi Komitet po Ispol'Zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko Energeticheskii Institut). 1971. 38p. (In Russian). INIS.

Expressions are given for calculating the turbulent mass transfer coefficient of liquid drops K_0 and for the fraction of liquid flowing in the core of the gas stream $\bar{E}$. The correctness of the formulas has been confirmed for the range of reduced gas stream velocities from 15 to 60 m/sec. It is shown that empirical relations for $\bar{E}$, which have been proposed by a number of authors, are partial cases of the analytical expression, and these relations are thus shown to have a physical basis. The analysis of the amount of material taken away shows that as a definite dimension in the Weber number it is desirable to use not the thickness of the liquid film but the difference between the amplitude of the rolling wave and the film thickness. It is shown that the quantity $\bar{E}$ is an increasing function of the velocity as a result of an increase in the amount of material taken away. The detachment of liquid drops from a single rolling wave is a decreasing function of the reduced gas velocity. (auth)

14773 (FEI-313) ANALYSIS OF DIVERGENCES IN SOME MEASURED AND CALCULATED FUNCTIONALS IN BFS-22 AND BFS-23 CRITICAL ASSEMBLIES. Dulin, V. A.; Voropaev, A. I.; Kazanskii, Yu. A.; Koloskov, B. V.; Mamontov, V. F.; Sidorov, G. I. (Gosudarstvennyi Komitet po Ispol'Zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko Energeticheskii Institut). 1971. 19p. INIS.

For two fast BFS assemblies a comparison is carried out on the measured and calculated ratios of the central reactivity coefficients and the cross-section ratios in the center of the assemblies. The observed discrepancies are interpreted as the result of errors in calculating the neutron flux and worth spectra. With changes in fission and capture cross-sections within the limits of 10% (in this case k_{eff} changed not more than 1%) it was possible to smooth the experimental and calculated values of the functionals, which are sensitive mainly to the neutron worth function. For smoothing within the framework of a homogeneous calculation of functionals sensitive only to the neutron spectrum, there is need for much greater changes both in the fission and capture cross-sections, and also in the elastic and inelastic moderator cross-sections. (auth)

14774 (IAEA-153, pp 261-272) DESIGNING OF OPTIMAL SET OF MICROSCOPIC EXPERIMENTS AND OF LIMITS ENSURING SPECIFIED ACCURACY IN CALCULATION OF REACTOR PARAMETERS. Usachev, L. N.; Bobkov, Yu. G. 1973. (In Russian).

From proceedings of a panel on neutron nuclear data evaluation; Vienna, Austria (30 Aug 1971).

Questions on the necessity of the accuracy of microscopic nuclear data, ensuring a specified accuracy in the calculation of reactor parameters, are discussed. A general method for taking into account the correlation of the errors of microscopic quantities, relative to different processes, different energy groups, and different isotopes, is developed. The error is examined as consisting of components distinguished from one another by correlation properties. Because of this separation simple formulas are obtained for the connection of this error component with the needed accuracy of reactor parameters. Methods for the planning of experiments were used for the mathematical formulation of problems on the least expensive combination of experiments ensuring a specified accuracy in the calculation of reactor parameters. The solution of the problems was obtained in the form of simple formulas. The requirements on all error components were calculated. The possibility of moderating the requirements during the measurement of the neutron flux by any method in σ_f and σ_c experiments was shown. The special importance of errors in the setting up of curves is indicated, and the special role of limits in the determination of these errors is emphasized. (tr-auth)

14775 (IEA-2250) NEW METHOD FOR THE CALCULATION OF HETEROGENEOUS REACTORS. Gorodkov, S. S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1973. 16p. INIS.

A new method which was called by the author a quasi-albedo method allows a rewriting of the two-dimensional diffusion equations with line sources-sinks in a form similar to finite-difference one. For this purpose the reactor is covered with the square grid of mesh lines with the spacing equal to the lattice pitch so that the line sources-sinks can be only in its mesh points. The neutron distribution in each grid cell can be constructed with high precision from the elementary distributions of only two types. The condition of maximum smoothness of the neutron field obtained in such a way leads to the equations connecting the external fields in the mesh points so that each point interacts directly only with eight nearby points. The preliminary calculations showed good accuracy of the new method. (auth)

14776 (LA-tr-74-1) CALORIMETRIC MEASUREMENTS OF THE ENERGY RELEASED BY ^{235}U FISSION PRODUCTS FOR DECAY TIMES BETWEEN 70 AND 7.16^6 SECONDS. Lott, M.; Lhiaubet, G.; Dufreche, F.; Devillers, C.; de Tourreil, R. Translated by A. Vakar and J. Yarnell From Bull. Inform. Sci. Tech. (Paris); No. 181, 51-59(1973). 20p. Dep. NTIS $3.00.

A calorimetric measurement of the energy released by the fission products of the thermal fission of ^{235}U for decay times between 70 and 7.10^6 seconds after one fission is presented. Allowing the rapid variation of the energy release compared to the response time of the calorimeter, two methods have been derived to solve the equation: $m(t) = d/dt \int_0^t A(t-\tau)E(\tau)d\tau$, where $E(\tau)$ is the desired quantity. Experimental measurements have been compared to theoretical calculations based on a recent compilation of fission product data. (8 references) (auth)

14777 (N-73-26670) REDTOP (REACTOR DESIGN FROM THERMAL-HYDRAULIC OPERATING PARAMETERS): A FORTRAN 4 CODE FOR CALCULATING REACTOR DIMENSIONS AND MASS FROM THERMAL-HYDRAULIC CONSIDERATIONS. Wilmer, D. L.; Hyland, R. E. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). May 1973. 75p. (NASA-TM-X-68236; E-7467). NTIS $5.75.

REDTOP, reactor design from thermal-hydraulic operating parameters, is a FORTRAN 4 version 13 code that performs a single-channel, thermal-hydraulic analysis on a nuclear reactor to determine the reactor radius and mass. In addition REDTOP may be used to perform preliminary parametric analyses of proposed nuclear reactor designs. Both cermet and ceramic fuel pins in a triangular array may be analyzed. Running time is about 0.03 minute per case on an IBM 7094-7044 direct couple system. (auth)

14778 (NIIAR-P-164) PROGRAM COMPLEX OF MULTIGROUP CALCULATION FOR TWO-DIMENSIONAL REACTOR BY BUBNOV-GALERKIN'S METHOD. Kukharenok, I. P. (Scientific Research Inst. of Atomic Reactors, Dimitrovgrad (USSR)). 1972. 39p. (In Russian). INIS.

The program considers macro- and micro-cross sections while taking into account the blocking of resonance cross-sections, the number of processes and multiplication coefficients, table of values and coefficients for inhomogeneity in the thermal field, the criticality of concentration changes and repeated calculation with coefficients of the spectral shape. The program is coded for the BESM-4 computer. Limitations are: number of groups 26, number of test functions in a given group 25, number of zones 40. This complex is formulated analogously to the standard programs in the IS-2 system. The volume of the complex is 8500 words. (auth)

14779 (NRCN-324) REVIEW ON THE VALIDITY OF DIFFUSION THEORY. Ronen, Y. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center Negev). May 1972. 21p. INIS.

A review on the validity of the diffusion theory in reactor theory is presented. The assumptions that lead to the diffusion equation and their range of validity are discussed. The main emphasis is on the energy independent case, but the energy dependent case and the telegrapher's equation are also taken into consideration. (auth)

14780 (RT/FI-(73)25) SUMMARY OF REACTOR PHYSICS ACTIVITIES IN ITALY IN THE PERIOD JULY 1972-JUNE 1973. Farinelli, U. (Comitato Nazionale per l'Energia Nucleare, Casaccia (Italy). Lab. Fisica e Calcolo dei Reattori). 27 Jul 1973. 27p. Dep. NTIS (U.S. Sales Only) $3.50.

Information on reactor physics research programs in Italy during July 1972 to June 1973 is presented under the following chapter headings: theoretical; experimental; light water reactors; heavy water reactors; fast reactors; high temperature graphite reactors; shielding; nuclear data evaluation and processing; and fusion reactors. 64 references. (DCC)

14781 (RT/FI-(73)26) REACTOR-NOISE AND STOCHASTIC NEUTRONICS AT C.S.N. CASACCIA: ADVANCEMENTS 1970-1972. Pacilio, N.; Jorio, V. M.; Farinelli, U.; Ferrari, T.; Lorenzi, P.; Malosti, D.; Businaro, T. Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1 Aug 1973. 26p. Dep. NTIS (U.S. Sales Only) $3.50.

Progress in reactor-noise analysis and stochastic neutronics at C.S.N. Casaccia is summarized, covering the three year period from 1970 to 1972. Part of the theoretical activity has been realized in cooperation with the United States National Science Foundation, the University of California-Berkeley and the University of Wisconsin. A comprehensive bibliography is given for specific details on the various matters of the survey. 7 references. (auth)

14782 (RT/FI-(73)28) ROLE OF INTEGRAL DATA. Farinelli, U. (Comitato Nazionale per l'Energia Nucleare, Casaccia (Italy). Lab. Fisica e Calcolo dei Reattori). 9 Aug 1973. 47p. Dep. NTIS (U.S. Sales Only) $4.50.

The problem of correlating information on nuclear data from differential measurements and from integral experiments is discussed in general terms; a schematic model for a global approach is presented. Applications to fast reactors and, more briefly, to thermal systems, shielding and radiation damage are reviewed. 45 references. (auth)

14783 (RT/FI-(73)30) β_{eff} AND THE INHOUR EQUATION FOR ^{235}U COMPACT FAST REACTORS. D'Angelo, A. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 5 Sep 1973. 55p. Dep. NTIS (U.S. Sales Only) $4.75.

An extensive analysis of the delayed neutron effective fraction for compact fast ^{235}U-fueled reactors, such as GODIVA and

TAPIRO, has been performed. The work is presented in three sections: 1) beta-effective theoretical backgrounds and analytic formulation; 2) hypothesis and details for GODIVA and TAPIRO calculations; 3) the BEFF2 program, which actually computes the beta-effective values and the inhour equation. 12 references. (auth)

14784 (WARD-XS-3045-4) PHYSICS EVALUATIONS AND APPLICATIONS. Quarterly Progress Report for Period Ending October 31, 1973. Paik, N. C.; Durston, C.; Davis, W.; Yarbrough, M. B. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Dec 1973. Contract AT(11-1)-3045. 28p. AT.

A preliminary ENDF/B-IV neutron data tape for ^{238}U has been made available to the National Neutron Cross Section Center (NNCSC), Brookhaven National Laboratory. The tape consists of the recently completed evaluation of resonance parameters by F. J. McCrosson, SRL and ARD's new evaluation of ^{238}U cross sections including the resolved inelastic level data evaluated by A. B. Smith at Argonne National Laboratory. The tape is now ready for Phase I review and preliminary testing against CSEWG benchmark critical assemblies for fast reactor applications. A working version of the SPHINX code (formerly Code 2) has been sent to Los Alamos Scientific Laboratory. (12 references) (auth)

14785 (WCAP-7757) PANDA CODE. Barry, R. F.; Emery, C. C. Jr.; Knight, T. D. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Sep 1971. 47p.

PANDA is a new two-group one-dimensional (slab/cylinder) neutron diffusion code designed to replace and extend the FAB series. PANDA allows for the nonlinear effects of xenon, enthalpy and Doppler. Fuel depletion is allowed. PANDA has a completely general search facility which will seek criticality, maximize reactivity, or minimize peaking. Any single parameter may be varied in a search. PANDA is written in FORTRAN IV, and as such is nearly machine independent. However, PANDA has been written with the present limitations of the Westinghouse CDC-6600 system in mind. Most computation loops are very short, and the code is less than half the useful 6600 memory size so that two jobs can reside in the core at once. 7 references. (auth)

14786 (WCAP-7758) TURTLE 24.0 DIFFUSION DEPLETION CODE. Altomare, S.; Barry, R. F. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Nuclear Energy Systems Div.). Sep 1971. 45p.

TURTLE is a two-group, two-dimensional (x-y, x-z, r-z) neutron diffusion code featuring a direct treatment of the nonlinear effects of xenon, enthalpy, and Doppler. Fuel depletion is allowed. TURTLE was written for the study of azimuthal xenon oscillations, but the code is useful for general analysis. The input is simple, fuel management is handled directly, and a boron criticality search is allowed. Ten thousand space points are allowed (over 20,000 with diagonal symmetry). TURTLE is written in FORTRAN IV and is tailored for the present CDC-6600. The program is core-contained. Provision is made to save data on tape for future reference. (auth)

14787 CALORIMETRIC MEASUREMENTS OF THE POWER EMITTED BY ^{235}U FISSION PRODUCTS FOR COOLING TIMES BETWEEN 70 AND 7.10^6 SECONDS. Lott, M.; Lhiaubet, G.; Dufreche, F.; Devillers, C.; de Tourreil, R. (CEN, Fontenay-aux-Roses, France). Bull. Inform. Sci. Tech. (Paris); No. 181, 51-59(May 1973). (In French).

A calorimetric method is presented for the determination of the power emitted by ^{235}U fission products for cooling times ranging from 70 seconds to 7.10^6 seconds after the fission. In order to measure a rapid varying power in relation to the constant response time of the calorimeter, two methods were developed to resolve the $m(t) = d/dt \int_0^t A(t-\tau)\, E(\tau) d\tau$ equation, $E(\tau)$ being the quantity sought. The experimental results are compared to a theoretical evaluation based on a recent compilation of fission product data. (FR)

14788 INVESTIGATION OF CRITICAL HEAT FLUX UNDER CONDITIONS OF NONUNIFORM HEAT ADDITION ALONG THE LENGTH OF A CHANNEL. Glushchenko, L. F.; Maevskii, E. M. (Kiev Polytechnical Inst.). Therm. Eng. (USSR) (Engl. Transl.); 19: No. 10, 109-112(Oct 1973).

Translated from Teploenergetika; 19: No. 10, 74-77(1972).

14789 ACTIVITIES ON REACTOR THEORIES AND CODES IN OSAKA UNIVERSITY. Sekiya, T.; Kitazoe, Y.; Yamamura, Y.; Yamamoto, K.; Takeda, T. (Osaka Univ., Suita, Japan). Newslett. ENEA Comput. Programme Libr.; No. 15, 31-36(Nov 1973).

It has frequently been necessary for reactor theorists to check the validity of used nuclear data along with the development of calculation methods of reactor constants and spectrum. However, the interest of nuclear physicists has not always covered the neutron energy range needed by reactor physicists. Therefore, nuclear models and theories should be developed to improve nuclear data on some physical basis other than the conventional ones. A theoretical expression of the microscopic cross-section is derived by taking account of the interference between resonance levels. Improved cross-sections are calculated so as to make some reactor constants approach experimental results. The principle of calculation codes is explained. The lattice calculation codes which have been developed on the basis of collision probability method are presented. 9 references. (auth)

14790 DETERMINATION OF THE α COEFFICIENT OF FISSILE MATERIAL BY THE REACTIVITY EFFECT OF THE DELAYED NEUTRONS. Faehrmann, K.; Hedderich, D.; Huettel, G. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Kernenergie; 16: No. 9, 284-287(Sep 1973). (In German).

A novel method of determining fissile material α is described. It is based on reactivity detection of the delayed neutrons of a fissile material sample. The specific problems are briefly discussed for the case of measuring $\alpha(^{235}U)$ in a thermal reactor. (12 references) (auth)

14791 MODULAR SYSTEM FOR NUCLEAR REACTOR CALCULATIONS ON THE BASIS OF THE MULTIGROUP P_1 OR MULTIGROUP DIFFUSION APPROXIMATION. Hennig, D.; Hoffmann, E.; Leser, W.; Sames, D.; Seume, T. (VEB Kombinat Kraftwerksanlagenbau, Berlin). Kernenergie; 16: No. 9, 278-284(Sep 1973). (In German).

Complex systems of programmes for the physical calculation of nuclear reactors are suitably composed of programme units (MODULEs) widely independent of each other which can be connected to each other via a control programme (STANDARDWEG) according to a given coupling matrix. Such a programme system working at present on the basis of the multigroup P_1 or multigroup diffusion approximation and mainly serving for the calculation of fast reactors has been realized. The structure of the programme system, the physical content of the MODULEs ready for calculation, and some experience gathered in working with the system are given. (20 references) (auth)

14792 APPLICATION OF THE MONTE-CARLO METHOD TO THE CALCULATION OF FAST REACTORS IN THE ROSSENDORF CENTRAL INSTITUTE FOR NUCLEAR RESEARCH. Barz, H. U.; Noack, K.; Seifert, E.; Wand, H. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Kernenergie; 16: No. 9, 274-277(Sep 1973). (In German).

A report is given of the works carried out in the field of applying the Monte-Carlo method to fast reactor calculations in the Reactor Theory Division of the Rossendorf Central Institute for Nuclear Research in the last years. Basis of these works is the programme DIMOS provided for solving the homogeneous neutron transport equation. Certain modifications of this programme allow the calculation of effective integral reactor parameters which can be represented by integrals over flux and importance functions and to take some effects of heterogeneity due to the space-dependent resonance self-shielding close to boundaries of material zones into consideration. Studies of the statistical errors have been carried out. Finally, the conceptions of further work in the field of shielding calculations are cleared up. (19 references) (auth)

14793 STUDIES ON THE CDM-1 CODE FOR EK-10 AND IRTM FUELED REACTOR. Biciolla, L.; Marcu, G.; Mociornita, G. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 18: No. 8, 1015-1022(1973).

The CDM-1 code written in FORTRAN-IV for the ICL-1900 deals with the numerical solution of the time independent, two dimensions, multigroup diffusion equations. The finite difference approximations of the continuous problem for both X–Y and R–Z geometries and the properties of the resulting matrix problem are given. Some practical applications for three nuclear systems are discussed. (5 references) (auth)

14794 OPTIMAL FLATTENING OF HEAT RELEASE IN A REACTOR. Zaritskaya, T. S.; Rudik, A. P. At. Energ. (USSR); 35: No. 3, 200-202(Sep 1973). (In Russian).

Equations are developed on calculating the optimum flattening of the heat release curve. The form of the curve depends on the nature of the individual components as well as on the reactor type. (TTT)

Reactor Components and Accessories

Refer also to abstracts 12668, 12972, 13066, 13122, and 13123.

14795 (GEAP-13968) GOGO USER'S MANUAL. Sim, R. G. (General Electric Co., Sunnyvale, Calif. (USA). Breeder Reactor Dept.). Aug 1973. Contract AT(04-3)-893. 50p. Dep. NTIS $5.45.

GOGO is a special purpose code which solves one- or two-dimensional generalized plane strain fuel rod cladding problems. Complete instructions for the use of the code are provided. The analytical basis and the programming details of the code are discussed. (auth)

14796 (INIS-mf-907) COMPARATIVE ANALYSIS OF LOGICS USED IN REACTOR PROTECTIVE SYSTEMS. Gangwal, D. K.; Ray, R. N. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 8p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

Redundancy and coincidence principles are extensively used in reactor protective and regulating systems to reduce random failure probability. The most common logics being used are "two out of four logic" and "two out of three logic". A criterion for the choice of the coincidence logic is developed using reliability models of reactor safety system which include: (i) sensor, (ii) amplifier and trip activator, (iii) logic relay coil and (iv) logic relay contacts. A figure of merit has been developed and evaluated by the use of conditional probability methods for various logics. This criterion can be utilized to decide the coincidence logic to be developed for reactor protective system. (INIS)

14797 (MRR-85) INVESTIGATION FOR THE SIMULATION OF FUEL PINS BY HEATING CONDUCTORS. Liesch, K. (Technische Univ. Munich (F. R. Germany). Inst. fuer Mess- und Regelungstechnik). Dec 1970. 19p. (In German). INIS.

A description is given of the quantitative investigation of heating conductor types by means of calculation. As a result of application of various combinations of the filling, heating tube, and canning material it is shown how the dynamic behavior of the simulator differs from that of the reactor fuel rod. A simple composition of instrumentation and power control gives the direct heating conductor priority over the indirect heating conductor for this type of simulation. It is the aim of this investigation to achieve the best possible imitation of the heat transferred per unit surface. (INIS)

14798 (RDT-F-2-7-T(11-73)) ACCEPTANCE SAMPLING PLANS. (USAEC Division of Reactor Research and Development, Washington, D.C.). Nov 1973. 121p. RSO.

A compilation is presented of attributes and variables acceptance sampling plans and procedures which may be used as a ready reference to provide protection to both supplier and purchaser whenever sampling inspection is involved. Some of the basic and underlying principles involved in these plans and procedures are discussed. The plans and procedures provide for selection of adequate sample quantities and evaluation of inspection data for the purpose of determining conformance to the specified lot tolerance percent defective (LTPD) and β error acceptance criteria. (auth)

14799 NUCLEAR REACTOR FUEL ELEMENT SPACER GRID. Seddon, T. (to United Kingdom Atomic Energy Authority). US Patent 3,772,148. 13 Nov 1973. Priority Date 3 Sep 1969, UK, United Kingdom of Great Britain and Northern Ireland. 6p.

A spacer grid for a nuclear reactor fuel assembly is of cellular form being constructed, for example, from two superimposed layers of cojoined tubular ferrules. Each of the fuel pins passes through a corresponding pair of ferrules in the two layers. Two circumferentially spaced rigid support members extend into one of each pair of ferrules and a single rigid support member extends into the other of the pair of ferrules. The fuel pin extending through each pair of ferrules contacts the rigid support members therein, the rigid support members being positioned at points on the corner of a triangle and the fuel pin being biassed into contact with the support members by a bow spring extending between the pair of ferrules. (Official Gazette)

14800 MAJOR MOTORS FOR NUCLEAR POWER STATIONS. Tilma, J. E. Power Eng.; 77: No. 9, 72-74 (Sep 1973).

Design requirements for the huge motors needed to drive water circulation pumps in PWR and BWR nuclear power plants are described. These motors in sizes of 6500 to 9000 hp weigh from 30,000 to 100,000 lb and measure from 10 to 17.5 ft in height and from 6.5 to 10 ft in dia. Requirements related to back rotation, emergency shutdown, bearing design, and considerations of radiation effects are discussed. (LCL)

14801 DEVELOPMENT CONCEPTS OF PRIMARY COOLANT RECIRCULATING PUMPS FOR NUCLEAR POWER PLANTS. Gaffal, K. (Sulzer-KSB Kernkraftwerkspumpen GmbH, Frankenthal, Ger.). (1973). vp. (In German).

From pump conference; Karlsruhe, Germany (2 Oct 1973).

The layout and design of primary coolant recirculating pumps is closely connected with the development of the various types of reactors. Reactor safety aspects have an influence on the design of reactors as well as on the design features of pressure retaining pump components. The rapid increase in pump capacities has affected the mechanical hydrodynamical layout of recirculating pumps. (GE)

14802 FUTURE PROSPECTS FOR THE PRESTRESSED CONCRETE REACTOR PRESSURE VESSEL. Cave, L. (Pollution Prevention (Consultants) Ltd., Crawley, Eng.). At. Energy Rev.; 11: No. 2, 305-339(1973).

The emergence of the HTR, embodying the prestressed concrete pressure vessel (CPV) concept, as a competitor to other thermal reactor types raises the question whether an increasing proportion of reactors will use CPVs. The various factors that could lead to the use of CPVs for LWRs, the feasibility of steel vessels being used for large GCRs and the effects on cost of a change in vessel material in each case are discussed. It is concluded that although these changes of vessel material are technically feasible, they are unlikely to occur in either the LWRs or GCRs, although circumstances are identified in which such changes would become more likely. Consequently the future prospects of the CPV depend mainly on the success of the HTR in competition with the LWRs and the success of the GCFR in competition with the LMFBR. (auth)

14803 LONG-TERM DAMAGES IN CONSTRUCTION COMPONENTS SUBJECT TO HEAT. II. Testing and Prevention of Premature Damage. Epperlein, H. (Technischer Ueberwachungs-Verein Bayern eV, Regensburg, Ger.). Tech. Ueberwash.; 14: No. 10, 289-291(1973). (In German).

The use of stress analysis and common safety inspections of individual structural components to determine defects in existing plants and to establish a specified range of safety hazard is discussed. Furthermore, consideration is given to how damage can be prevented or at least delayed by using stress analysis during the design and construction and by testing and quality control during component fabrication and assembly by welding prior to acceptance. (GE)

14804 MAIN COOLANT PUMPS FOR NUCLEAR POWER STATIONS. Versollmann, W. (Maschinenfabrik Andritz AG, Graz-Andritz, Austria). (1973). vp. (In German).

From pump conference Karlsruhe 73; Karlsruhe, Ger. (2 Oct 1973).

Main coolant pumps used as circulating pumps in primary loops require particularly high standards on the part of the manufacturer as regards working reliability of the units. To meet these demands, extensive investigations are necessary, both concerning hydraulics and the functional behavior of the essential pump components. The design conception of the reactor coolant pumps was based on the experience gained in the different branches involved. Continued research and development work maintains the technical knowledge on the latest level. (GE)

14805 NUCLEAR REACTOR WITH A PRESTRESSED METAL PRESSURE VESSEL. (to Stempelkamp Giesserei KG). German Patent 1,614,394. 19 Nov 1970. Filed Date 23 Jan 1968. (In German).

A description is given of a nuclear reactor with a metallic prestressed pressure vessel intended to receive the reactor core. This pressure vessel is made of cast iron and its walls are of sufficient thickness to assure shielding. This thickness is regulated by known methods. (TSS)

14806 CENTERING DEVICE FOR NUCLEAR REACTOR LOADING MACHINES. Kumpf, H. (to Siemens AG). German Patent 1,614,459. 13 Aug 1970. Filed Date 18 Mar 1967. (In German).

A description is given for a centering device for loading machines for pressurized water and boiling water nuclear reactors. At the lower extremity of the charge tower there is a tubular centering device longitudinally movable the lower edge of which is conical, in such a way that a fuel element can be aligned with the tower on which it is placed. (TSS)

14807 GRAPPLE, ESPECIALLY FOR TRANSPORTING NUCLEAR REACTOR FUEL ELEMENTS. Manthey, H. J.; Neumann, H. (to Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt mbH). German Patent 1,900,891. 20 Aug 1970. Filed Date 9 Jan 1969. (In German).

A grapple of a lifting apparatus consists of several clamps situated in a grapple box and capable of being moved one toward the other radially, operated by a common command apparatus; this grapple of the lifting apparatus is studied especially for the

transport of nuclear reactor fuel elements, characterized by the fact that these clamps are preferably of the form of one arm pivoting on two arms. (TSS)

14808 EXCHANGE CONTAINER FOR THE LOADING AND UNLOADING OF NUCLEAR REACTOR FUEL ELEMENTS. Mundt, D. (to Interatom Internationale Atomreaktorbau). German Patent 1,564,131. 8 Jan 1970. Filed Date 18 Mar 1966. (In German).

The reactor is provided with a base that contains a sealing device for the channel for the entrance of the fuel element. The base is placed with its lower face on the opening provided at this place in the cover of the reactor. With the aid of means of grasping the fuel elements, one can lift them and place them in the entrance channel of the exchange container and replace them by others. (TSS)

14809 COUNTER FOR MEASURING THE OXIDE CONTENT IN LIQUID METAL CYCLES. Dumm, K. (to Interatom Internationale Atomreaktorbau). German Patent 1,813,819. 2 Jul 1970. Filed Date 11 Dec 1968. (In German).

The counter for measuring the oxide content in liquid metal cycles such as liquid sodium coolant cycles in nuclear reactors is characterized by a cylindrical cavity arranged in a cooling channel. The cavity is provided with a measuring platform, an entrance tube, and an outlet tube, reaching deep into the measuring cavity as well as three pyrometer probes penetrating the measuring platform. (TSS)

14810 FLUIDIC-CONTROLLED AUTOMATIC RABBIT SYSTEM. Stelzer, F. (Kernforschungsanlage, Juelich, Ger.). Kerntechnik; 15: No. 10, 445-449(Oct 1973). (In German and English).

An automatically operating rabbit system was developed and tested for the series irradiation of small quantities of material. Control is by means of fluidic logic elements. The peripheral sensors (for example, the arrival signal in the radiation field) also operate by fluidics. (GE)

14811 HIGH UNIT CAPACITY POWER PLANTS OPERATING WITH A CYCLE OF TWO MEDIA. Szentgyorgyi, I. Energ. Atomtech.; 25: No. 10, 441-449(Oct 1972). (In Hungarian).

The capacity of the power plant block to be built with a single shaft is limited by the large specific volume of water-steam. This problem is solved by substitution for the cold end of the water-steam turbine through ammonia turbine, so the unit capacity of turbines can be increased. At low capacities the ammonia system can be applied in regions with cold climates. The air condensation can be highly advantageous. At the nuclear power plants it can be efficiently ensured by the system of two working media that the radioactive media should not get into the cooling tower. By the application of a second working medium there can also be left out the middle moisture precipitator and the steam superheater needed at systems of saturated steam. On the basis of this study a cycle of advantageous efficiency can be realized by controlling the boundary temperatures of water steam and ammonia as well as by careful design of the thermal flow diagram. (auth)

14812 POWER STATION TURBINE PLANT: ONE OF THE MOST IMPORTANT COMPONENTS OF THE POWER INDUSTRY. Lavenenko, K. D.; Troyanovskii, B. M. Therm. Eng. (USSR) (Engl. Transl.); 19: No. 11, 1-6(Nov 1972).

Translated from Teploenergetika; 19: No. 11, 2-5(1972).

The development and performance characteristics of steam turbines for nuclear power plants are reviewed. (DCC)

14813 REDUCED FRICTION ANNULAR CAVITY FOR THE PLUG OF A NUCLEAR REACTOR PRESSURE VESSEL. Kumpf, H. (to Siemens AG). German Patent 1,600,590. 23 Apr 1970. Filed Date 24 May 1967. (In German).

A description is given of a reduced friction annular cavity for the cover of a nuclear reactor pressure vessel to equalize the varying expansion of material. It is characterized by the fact that a large number of flattened rolling mechanisms on two sides of the support points are provided. They are fixed in their prescribed position by special devices being displaced in the direction of the different expansions of the material. (TSS)

14814 REACTOR TEST: TESTING SYSTEM FOR PERIODICAL INSPECTION OF REACTOR VESSELS FOR NUCLEAR PLANT. Junghem, A. (Tekniska Roentgencentralen AB, Stockholm). Svetsen: 31: No. 4, 54-62(Aug 1972). (In Swedish).

The demand for periodical inspection of reactor vessels for nuclear power plants has caused a partially new inspection technology to be developed. The inspection is mainly made by means of mechanized, remote controlled inspection devices and by using nondestructive testing, mainly by ultrasonics, and visual inspection by television camera. The purpose for the inspection is to indicate during service eventually appeared changes in material and welds, especially crack formation. High demands are i. a. put to the possibility of reproducing the inspection results. The U. S. ASME Code, Section XI has become dominating with regard to extent of inspection and demands. In Sweden, inspection equipment and inspection systems have been developed for periodical inspection of the reactor vessel for the Oskarshamn Plant, reactor set No. I and a so-called finger-print inspection has been made. Actually, work is carried out for completing similar equipment for the reactor vessels of the nuclear plants which are actually under construction in Oskarshamn, Ringhals and Barsebäck. (auth)

14815 HOUSING STRUCTURE FOR NUCLEAR REACTOR CORE. Schilling, F. E. (to Siempelkamp Giesserie KG). Canadian Patent 919,822. 23 Jan 1973.

A pressure vessel for a nuclear reactor is made of interlocking cast-iron plates. It is prestressed by tensioning rods passing through the plates. The plates are preferably cemented together by means of a heat-resistant epoxide cement filled with metal powder. The pressure vessel provides shielding as well as containment. It can be used for reactors containing a pressurized gas, as well as for pressurized-water or BWR reactors. (CA)

14816 DEVELOPMENT OF REACTOR ANOMALY DIAGNOSIS SYSTEM. Osawa, Y.; Kato, K.; Shimeji, N.; Sano, K. (Hitachi Ltd., Kawasaki, Japan). Hitachi Hyoron; 55: No. 8, 839-843(Sep 1973). (In Japanese).

A reactor anomaly diagnosis system which is capable of detecting abnormal conditions of a reactor in early stage and thereby preventing them from developing into a fault or breakdown has been developed. The system consists of an input data process unit which collects from the data logger such reactor signals concerning reactor power, control rod position, coolant inlet and outlet temperatures, etc., a central process unit HITACHI computer 10 which detects the anomaly and determines the cause of the detected anomaly, and a color display unit which indicates the result of computation. In a field test conducted at the Japan Atomic Energy Research Institute, in which a material testing reactor (JMTR) was used, the system proved to have an anomaly detecting capability of 2 cent in terms of reactivity, and ±2°C in terms of coolant temperature change, and the time from signal collection to computation result indication was 1.5 sec. The abnormal conditions to be dealt with this system fall under the following three categories, i.e., the variation of operational conditions, anomalies in the reactor signal system, and unknown reactivity insertion, and expected percentage of correct judgement for the above abnormal conditions is more than 90%. (auth)

14817 STUDY OF NEUTRON SPECTRA IN REACTOR SYSTEMS WITH HYDROGENOUS MODERATOR OF VARIABLE DENSITY. Lomakin, S. S.; Panfilov, G. G.; Petrov, V. I.; Samoilov, P. S.; Fofanov, V. S. pp 17-22 of Yadernoe Priborostroenie. Moscow; Atomizdat (1972). (In Russian).

The integral method of measuring the effective neutron temperature in reactor systems with variable density of the hydrogen-containing moderator was examined. It was shown that the energy spectrum of the neutrons becomes very hard to the extent of the decrease of the concentration of the hydrogen in the moderator. (tr-auth)

14818 MEASUREMENT OF THE RATIO OF FISSION PRODUCT GAMMA ACTIVITIES FROM ^{239}Pu AND ^{235}U FISSIONS. Tsuruta, H. (Japan Atomic Energy Research Inst., Tokai). J. Nucl. Sci. Technol. (Tokyo); 10: No. 9, 560-565(Sep 1973).

The ratio of the γ-activities per fission from fission products of ^{239}Pu and ^{235}U, and its time dependence were measured by double fission chamber technique. The γ-activity from the fission products of ^{239}Pu fission was lower than the corresponding activity relevant to ^{235}U fissions. The ratio varied with the cooling time allowed after irradiation. This ratio was applied to power distribution measurements by γ-scanning method in multi-region cores composed of PuO_2-UO_2 and UO_2 fuels. To obtain the relative power, the measured γ-activities from the fission products in the fuel rods were corrected for the difference between the γ-activities per fission from the fission products. (auth)

14819 LOCKING DEVICE FOR NUCLEAR REACTOR FUEL OR MODERATOR CONTAINERS. Rothfuss, H. (to Interatom Internationale Atomreaktorbau). German Patent 1,564,217. 19 Feb 1970. Filed date 17 Dec 1966. (In German).

A locking device for containers of fuel or moderator of a nuclear reactor with a grill plate is described. The device is characterized by the fact that there is an adjustable lock (bolt) mounted axially on the ring of the elevator for the base of the cassette that takes the locking position in the grill plate under the action of a force and that returns to the locked position by an adjustment relative to the ring of the elevator. (TSS)

14820 ROTATING REACTOR COVER WITH CONVECTION BARRIER FOR SODIUM VAPOR. Rothfuss, H.; Kohler, M. (to Interatom Internationale Atomreaktorbau). German Patent 1,813,820. 8 Oct 1970. Filed date 11 Dec 1968. (In German).

A rotating cover is described for a nuclear reactor cooled by a liquid metal, such as liquid sodium, which serves as a convection barrier to prevent the penetration of sodium vapors into the interior of the reactor. This cover is characterized by the fact that it is supported in such a fashion that it can be raised or lowered on a collar that is located in the interior of the reactor. (TSS)

14821 FUEL CHANNEL END CLOSURE SEAL. Campbell, G. R. (to Canadian General Electric Co. Ltd.). Canadian Patent 919,318. 16 Jan 1973.

An end-seal for a nuclear fuel channel consists of a deformable dome which is placed in the channel and then expanded by turning a screw. A spring opposes the action of the screw. The dome is preferably made of a titanium alloy, or a hardenable Ni–Al alloy such as Duranickel 301. (CA)

14822 DESIGN AND REALIZATION OF STEAM TURBINES. Koenig, H. H. Ind.-Anz.; 95: No. 46, 974-976(1973). (In German).

Superheated steam turbines up to 680 MW with 3,000 rpm and saturated steam turbines up to 1,300 MW with 1,500 rpm constructed in the FRG, are described. The design of the blades and cases allows higher power loading with this construction. (GE)

14823 STANDARDIZATION AND UNIFICATION OF IN-CORE NEUTRON FLUX DENSITY MEASUREMENTS. Arabei, B. G.; Bochin, V. P.; Garapov, E. F.; Lomakin, S. S.; Petrov, V. I.; Samoilov, P. S.; Khmyzov, V. V. pp 3-8 of Moscow; Atomizdat (1972). (In Russian).

Questions were considered on the standardization and unification of means and methods for the measurement of the parameters of the neutron field in reactors in order to guarantee unity and accuracy in the measurement of these parameters. One way of standardization appears to be the use of activation detectors. Recommendations were made on the composition of standard collections of activation detectors. The use of standard thermal neutron sources, based on the calibration of the F-1 reactor was proposed for calibration of detectors used for continuous measurements on the reactor. The parameters of the neutron field in the reactor (relative current density, epithermal parameters, and the neutron gas temperature) were measured by means of activation detectors with errors of 2.5 to 3%. The use of these sources makes possible the calibration of neutron detectors with an error of 4 to 7%. (tr-auth)

14824 NUCLEAR REACTOR FUEL ELEMENTS. Clapham, L. (to United Kingdom Atomic Energy Authority). US Patent 3,775,249. 27 Nov 1973. Priority date 29 Oct 1970, United Kingdom of Great Britain and Northern Ireland. 2p.

The invention relates to a nuclear reactor fuel element assembly which is in the form of a bundle of parallel fuel pins extending between top and bottom end fittings in the assembly. The top and bottom end fittings are held together by a number of lifting pins which are screwed into the bottom end fitting and have spigots extending through the top end fitting and fitted with retaining nuts. A fuel pin locking member consists of a U-shaped split pin having its legs extending through transverse drillings in the retaining units and spigots of two adjacent pins. Thus the retaining nut of each pin is locked to the spigot and the locking member prevents relative rotation between the pins and hence prevents unscrewing of the pins from the bottom end fitting. (Official Gazette)

14825 DEVELOPMENT OF AN AIR GAUGE FOR MEASURING IN REACTOR CREEP OF TUBULAR SPECIMENS. Ibrahim, E. F.; Winegar, J. E. (Chalk River Nuclear Labs., Ont.). J. Phys., E (London); 6: No. 9, 884-888(Sep 1973).

A six-nozzle plug air gage was developed to measure diametral creep of tubular specimens of 23 mm internal diameter for distances up to 7.5 m within a nuclear reactor. The progressive changes made to the air gaging system to increase range, improve reproducibility and decrease response time are described. The present system can measure up to a difference of 0.65 mm between the diameters of the gage head and that of the tube being measured. The system is reproducible to +0.002 mm for diameter differences of less than 0.2 mm and to ±0.02 for a diameter difference of 0.55 mm and has a response time of 2 sec. (auth)

14826 CHARACTERISTICS AND PERFORMANCE LIMITS OF CONDENSATION STEAM TURBINES WITH VARIATION OF THE LOAD PRESSURE. Com. Naz. Energ. Nucl., Notiz.; 19: No. 8-9, 100-105(1973). (In Italian).

A study is presented of an essentially orientive character on the influence of factors which limit the interval of exhaust pressure values and between which a given turbine can function continuously and maintain a constant steam output. The approximations are non-rigorous and the numerical values have an indicative value. The purpose of the study is to propose a type of approach to the problem of performance limits. (tr-auth)

14827 DEVICE FOR SUSPENDING AND SUPPORTING A REACTOR PRESSURE VESSEL IN A NUCLEAR POWER PLANT. Scholz, M.; Wakonig, F. (to Siemens Aktiengesellschaft). US Patent 3,775,250. 27 Nov 1973. Filed Date 17 Mar 1971. 4p.

A device is described for suspending and supporting a reactor pressure vessel in a reactor chamber of a nuclear power plant and includes a cover for the reactor chamber formed with an opening through which the pressure vessel extends into the reactor chamber, the cover being of compartment-shaped steel construction, support paws extending from the outer surface of the reactor pressure vessel, and support brackets located below the cover and secured thereto so as to form a structural entity therewith, the support paws being supported on the support brackets. (Official Gazette)

14828 IRRADIATION SURVEILLANCE CAPSULE ASSEMBLIES FOR NUCLEAR REACTORS. Blatter, A. J. (to Combustion Engineering, Inc.). US Patent 3,773,615. 20 Nov 1973. Filed Date 21 Apr 1971. 8p.

In an improved irradiation surveillance capsule assembly for nuclear reactors, means are provided for positioning and coupling together a plurality of specimen compartments of the irradiation surveillance capsule assembly. Each capsule assembly has, in a train-type arrangement, a series of specimen compartments having wedge-shaped end caps which mate with complementary shaped end caps on adjacent compartments. The mating end caps are coupled together for limited relative movement so as to permit transverse off-setting of the specimen compartments upon the application of a longitudinal force whereby the movement will cause the compartments to become wedged against the sides of rectangular irradiation surveillance capsule assembly holders positioned within the reactor so as to eliminate vibration in the specimen compartment train of the capsule assembly. (Official Gazette)

14829 SWITCH FAILURES AT NUCLEAR FACILITIES. Culbert, W. H. Nucl. Safety; 14: No. 6, 660-663(1973).

Switch failures in nuclear power plants are reviewed for the period 1964 to March 1973. The types of failures, systems affected, and the number of failures are tabulated, and techniques for minimizing failures are discussed. (auth)

14830 NUCLEAR REACTOR COMPRISING A CORE COVER. Aubert, M. (to Commissariat a l'Energie Atomique). US Patent 3,773,616. 20 Nov 1973. Priority Date 15 Oct 1970, France. 4p.

A core cover is carried by an inner rotating shield plug which is mounted in eccentric relation to an outer rotating shield plug and is smaller in diameter than the outer plug and the reactor core. The cover forms above the core a lateral projection with respect to the inner plug. The rotation of the inner plug about its own axis is intended to free part of the reactor core so as to permit handling of fuel assemblies within the core by means of an articulated handling arm which is carried by the outer plug. (Official Gazette)

14831 FEED-THROUGH CONNECTION FOR A PRESSURE VESSEL, ESPECIALLY A NUCLEAR-REACTOR SHELL. Schastall, H. G.; Fuerste, W. O. A. (to Fried Krupp Gesellschat mit Beschrankter Haftung). US Patent 3,779,865. 18 Dec 1973. Filed Date 12 Oct 1970. 6p.

The concrete shell of a nuclear reactor, through which conduits extend, is formed with a feed-through connector anchored in the wall of the structure. The connector includes a self-blocking safety snap-action conduit coupling surrounded by a containment including a metallic duct, a pressure reducing packing received in the duct around the conduit, and means for evacuating the annular space about the latter to eliminate leakage fluids. (Official Gazette)

Reactor Fuels

Refer also to abstracts 13063, 13070, 13072, 13083, 13085, 13086, 13126, 13141, 13166, 13196, 14763, and 15013.

14832 (INIS-mf-909) COMPARATIVE STUDY OF FAILED FUEL DETECTION SYSTEMS. Arora, K. K.; Dhodapkar, S. D.; Jindal, R. N.; Menezes, P. F. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 7p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

An experimental program has been prepared to make a com-

parative study of the possible methods for detecting and locating a failed fuel element in reactors. They are, gaseous fission product monitoring, delayed neutron monitoring and radioiodine monitoring. Another method based on the fact that fission products ^{99}Mo and ^{132}Te are preferentially adsorbed on the surface of nickel bearing materials is considered promising. The experimental facility consists of an engineering loop. The physics aspects of the experiments and also the details of the loop are presented. Precautions are taken against the health hazards and the procedure of handling the activated materials also considered. (INIS)

14833 COMPARISON OF SPHERE-PAC AND PELLET $(U,Pu)O_2$ FUEL PINS IN LOW BURNUP INSTRUMENTED IRRADIATION TESTS. Fitts, R. B.; Miller, F. L. (Oak Ridge National Lab., TN). Nucl. Technol.; 21: No. 1, 26-38(Jan 1974).

Three irradiation tests were conducted in the Oak Ridge Research Reactor to evaluate and compare the low-burnup (0.5% FIMA) performance of Sphere-Pac and pellet fuels. The stainless-steel-clad $(U,Pu)O_2$ fuel pins were fabricated at a smear density of 82% of theoretical and irradiated in a fully instrumented capsule. The capsule position was varied to control fission heating, and the fuel center temperatures, cladding temperatures, and heat generation rates were measured. The data from these tests showed, at the 99% confidence level, that the thermal conductance of the Sphere-Pac fuel pin was 11.7 ± 1.2% better than that of the pellet fuel pin. This result was attributed to better heat transfer across the fuel-cladding interface with the Sphere-Pac fuel form. In addition, the Sphere-Pac fuel was more compatible with cladding than the pellet fuel, even though the maximum cladding temperature was higher on the Sphere-Pac fuel pin. Both fuel types restructured thermally at the same temperatures. 25 references. (auth)

14834 NUCLEAR FUEL ELEMENTS. McDonald, G. E. (to National Aeronautics and Space Administration). US Patent 3,759,787. 18 Sep 1973. Filed Date 30 Sep 1960. 4p.

A method for cladding tungsten–uranium dioxide fuel plates with tungsten is described. (LCL)

14835 FUEL ROD FOR NUCLEAR REACTOR. Allex, F. (to Nuklear Chemie und Metallurgie). German Patent 1,910,432. 10 Sep 1970. Filed Date 1 Mar 1969. (In German).

A fuel rod for a nuclear reactor with piles of segmented fuels is described. The cross section of the fuel can is constricted at the points of fixation of the spacers. (TSS)

14836 FUEL ELEMENT FOR NUCLEAR REACTORS. (to Euratom). Dutch Patent 7,114,862. 28 Oct 1971. (In Dutch).

Available from the Commission of European Communities, Luxembourg.

In a fuel element for a breeder wherein the breeding material is disposed centrally and is surrounded by the fissile material it is advantageous, if the breeding material is an oxide carbide or nitride of an actinide, to add a small percentage of actinide metal to the breeding material. The metal serves as a getter for the free oxygen, carbon or nitrogen respectively, liberated when the reactor is in use, and while the fissile material under those circumstances has a higher temperature than the breeding material migration of the metal is avoided. (EU)

14837 VENTED FUEL SYSTEM. Zebroski, E. L. (to United States Atomic Energy Commission). Danish Patent 126,674. 6 Aug 1973. Filed Date 28 Dec 1967. 12p. (In Danish).

A vent is described for a nuclear reactor fuel element which permits the holdup of gaseous and volatile fission products until a substantial portion of the radioactive precursors have decayed and the controlled release of long-lived gaseous and volatile radioactive fission products. (DE)

14838 FUEL ELEMENT FOR REACTOR CORES. Spalthoff, W. (to Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffhart mbH). Filed Date 13 Mar 1968. (In German).

A reactor fuel element is characterized by a can of Zircaloy or other zirconium alloy for the nuclear fuel and at an interior in which a metal or an alloy is arranged to serve to capture the hydrogen. (TSS)

14839 PROCESS AND DEVICE FOR EQUALIZING DIFFERENCES BETWEEN INTERNAL AND EXTERNAL PRESSURES OF NUCLEAR REACTOR FUEL ELEMENTS. Dorner, S.; Schretzmann, K. (to Gesellschaft fuer Kernforschung). German Patent 1,943,670. 11 Mar 1971. Filed Date 28 Aug 1969. (In German).

14840 FUEL ROD END PLUG. Wyatt, B. S.; Feraday, M. A. (to Atomic Energy of Canada Ltd.). Canadian Patent 906,693. 1 Aug 1972.

Uranium silicide end plugs are tightly fitted to hollow uranium silicide fuel rods by shrinking them in. The plugs preferably have a higher silicon content (4.2 to 4.6%) than the rods (3.6 to 4.0%). Differential shrinkage is produced by heat treatment. Preferably, the plugs are heat treated at 750 to 900°C for 2 to 300 hours, they are pushed in and then the whole assembly is heat treated first at 1000°C for 5 to 30 minutes, secondly at 750 to 900°C for 2 to 300 hours. (CA)

14841 METHODS FOR THE EVALUATION OF THE EFFICIENCY OF THE FUEL ELEMENTS OF HIGH-TEMPERATURE NUCLEAR REACTORS. Naumov, V. A.; Nelaev, V. V.; Khval, E. I. (Inst. of Nuclear Energy, Minsk). Vestsi Akad. Navuk Belarus. SSR, Ser. Fiz.-Energ. Navuk; No. 2, 16-25(1973). (In Russian).

Methods for the computation of radiation and thermal stability of the cylindrical fuel elements at high temperatures and irradiations of the fuel are described. The surface temperature of the fuel is predicted using both the model of the gas gap conductance and that of the contact conductance. Temperature distributions in the fuel are used for determination of the quantity of the fission product gases escaped from UO_2, fuel swelling, determination of cracking of the fuel pellets, and also for the estimation of fuel and sheath thermal expansions. Numerical computations were performed using the computer "Minsk-22". (auth)

14842 ROLE OF DIFFUSION IN THE PROCESS OF FISSION PRODUCT OUTPUT FROM CHEMONUCLEAR FUEL. Savushkin, I. A. (Inst. of Nuclear Energy, Minsk). Vestsi Akad. Navuk Belarus. SSR, Ser. Fiz.-Energ. Navuk; No. 2, 5-7(1973). (In Russian).

The expression for fission products output is given when chemonuclear fuel is in the form of a plate without cladding. Based on the examples of fuel layers from UO_2, the diffusion output value is given as the function of fuel layer thickness in the temperature range of 800 to 2000°C. (auth)

14843 METHOD FOR THE MANUFACTURE OF PLUTONIUM-CONTAINING NUCLEAR FUEL RODS. Stoll, W. (to ALKEM GmbH). US Patent 3,778,885. 18 Dec 1973. Priority Date 24 Jul 1971, F. R. Germany. 6p.

Nuclear fuel rods are manufactured by coating the inner wall of the tubular casing of the fuel rod with a layer of plutonium-containing matrix so that the plutonium is disposed only in the cylindrical outer zone of the uranium-containing nuclear fuel charge. This is done by preparing a suspension of plutonium-containing particles in a lacquer which can be decomposed into carbon by a heat treatment, passing the suspension through the tubular casing and heating the dried coating of the suspension in a protective inert atmosphere until the lacquer is carbonized. (Official Gazette)

14844 UTILITY QUALITY ASSURANCE PROVISIONS FOR MIXED OXIDE FUEL. Denning, R. F. (General Public Utilities Service Corp., Parsippany, NJ). Nucl. Mater. Manage.; 11: No. 3, 150-179(Fal 1973).

From proceedings of the 14th annual meeting of the Institute of Nuclear Materials Management, Inc.; San Diego, CA (20 Jun 1973).

The scale of plutonium recycle should climb sharply in the next few years reaching a total of more than fifty reloads per year by 1980. Utilities involved will be responsible for the integrity of the mixed oxide fuel. A series of quality assurance considerations which differentiate this fuel type from enriched uranium designs are presented. The areas of design, manufacturing, quality control, and on-site procedures are handled. Particular attention is devoted to the particle size distribution of the PuO_2 agglomerates in the UO_2 matrix. A variety of corrections are discussed appropriate for transforming the results of alpha radiography (or equivalent techniques) into a volume particle distribution. 11 references.

Reactor Control Systems

Refer also to abstract 13084.

14845 (GULF-GA-A-12733) PUBLIC SERVICE COMPANY OF COLORADO 330-MW(e) HIGH-TEMPERATURE GAS-COOLED REACTOR RESEARCH AND DEVELOPMENT PROGRAM. Quarterly Progress Report for the Period Ending September 28, 1973. (Gulf General Atomic Co., San Diego, Calif. (USA)). 31 Oct 1973. Contract AT(04-3)-633. 35p. Dep. NTIS $4.00.

The research and development program for the Public Service Company of Colorado 330-MW(e) High-temperature Gas-cooled Reactor is reviewed. Studies of component development, such as auxiliary equipment and special tools, and nuclear analysis of the fuel cycle, fuel zoning, and power shaping are included. The fuel development and fuel element proof testing programs include demonstration testing of the performance of test fuel elements by

means of irradiation at expected operating temperatures and capsule irradiation tests of production fuel. Studies covering the components of the steam generator under operating conditions are included. Experimental procedures and results are discussed and, where appropriate, the data are presented in tables, graphs, and photographs. More detailed descriptions of experimental work are presented in topical reports, and these are listed at the end of the report. (auth)

14846 (GULF-GA-A-12799) HTGR GAS TURBINE POWER PLANT CONTROL AND SAFETY STUDIES. Quarterly Progress Report for the Period July 1, 1973–September 30, 1973. (Gulf General Atomic Co., San Diego, Calif. (USA)). 29 Oct 1973. Contract AT(04-3)-167. 39p. Dep. NTIS $4.00.

Information on the HTGR gas turbine development program is presented concerning control system design and analysis and safety analysis. Research work on the control system includes: plant steady-state performance; transient analysis program; precooler transient characteristics; plant transient performance; and system control requirements. Information on the safety analysis includes: duct rupture accidents; PCRV safety configuration studies; safety implications of balance-of-plant studies; and seismic studies and environmental impact. (DCC)

14847 (INIS-mf-908) HARDWARE OF THE CENTRAL DATA PROCESSING SYSTEM FOR FBTR. Sreenivasan, P.; Singh, S. R. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 13p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

The hardware of the real time subsystem and the scientific subsystem are presented with the help of the block diagram. The subsystem I is used for the on-line control of the FBTR and the subsystem II acts as a standby for the emergency takeover of the on-line load. The characteristics of the central processor, the memory and the peripheral equipment are explained. The input and output of analog and digital informations under computer control are described. The consideration of reliability and the switch-over of the real time peripherals between the on-line processor and the backup processor with the help of a watchdog circuit is explained. It is concluded that the overall reliability of the system is very high because of I.C. usage and if the expected reliability is achieved the MTBF for both the processors together may be of the order of several years. (INIS)

14848 (INIS-mf-910) REACTIVITY CONTROL REQUIREMENTS IN VIEW OF D_2O DURING ELIMINATION IN 200 MW MODIFIED REACTOR. Rustagi, R. S.; Iyer, S. S. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 8p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

In the Narora Atomic Power Project, the moderator dumping and level control has been eliminated and the reactivity control is being achieved completely by means of a set of control rods which carry out day-to-day control of the core, provide adequate reactivity boost for start-up of the core after a shutdown and also fulfil primary and secondary shutdown requirements. The guidelines chosen in deciding the control-worths of these control rods with specific attention to reactor safety under postulated accident conditions are explained. The elimination of moderator dumping has been found to be feasible proposition and, in fact, economical. (auth)

14849 (MRR-126) PROCESS COMPUTERS FOR SUPERVISORY PURPOSES IN NUCLEAR POWER PLANTS. Buettner, W. E. (Technische Univ. Munich, Garching (F. R. Germany). Lab. fuer Reaktorregelung und Anlagensicherung). May 1973. 58p. (In German). Dep. NTIS (U.S. Sales Only) $5.00.

A survey of the use of process computers in nuclear power plants for control purposes is presented. The present state of the art is described briefly and the development potential of approved applications is pointed out. In addition, ideas about new control methods, especially concerning fast alarm analysis and incipient failure detections, are presented. The extended literature survey, which is reflected in the list of references, is a guide to problems which are treated only briefly in this report. (95 references). (auth)

14850 (N-73-25720) FAST-SPECTRUM SPACE-POWER-REACTOR CONCEPTS USING BORON CONTROL DEVICES. Mayo, W. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Jun 1973. 33p. (NASA-TM-X-2821; E-7354) NTIS $3.00.

Several fast-spectrum space power reactor concepts that use boron carbide control devices were examined to determine the neutronic feasibility of the designs. The designs considered were a 199-fuel-pin, 12-poison-reflector-control-drum reactor; a 232-fuel-pin reactor with 12 reflector drums and three in-core control rods; a 337-fuel-pin design with 12 incore control rods; and a 181-fuel-pin design with six drums closely coupled to the core to increase reactivity per drum. Adequate reactivity control and excess reactivity could be obtained for each concept, and the goals of 50,000 hours at 2.17 thermal megawatts with a lithium-7 coolant outlet temperature of 1222°K could be met without exceeding the 1-percent-clad-creep criterion. Heating rates in the boron carbide were calculated, but a heat transfer analysis was not done. (auth)

14851 (RDT-E-6-25-T(5-73)) CONTROL ROD ABSORBER PIN FOR LIQUID METAL FAST REACTORS. (USAEC Division of Reactor Research and Development, Washington, D.C.). May 1973. 16p. RSO.

Requirements for absorber pins for liquid metal fast reactor control rod assemblies are presented. (auth)

14852 (RDT-E-6-30-T(5-73)) ABSORBER PIN BORON CARBIDE PELLET. (USAEC Division of Reactor Research and Development, Washington, D.C.). May 1973. 14p. RSO.

The requirements for boron carbide pellets to be used in nuclear reactor control rod absorber pins are presented. (auth)

14853 (TM-63-2-1) FAST REACTOR THRUST CONTROL SYSTEMS APPLICABLE TO A NUCLEAR POWERED SPACE CRAFT. Gorker, G. E. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). [1963]. Contract AT(40-1)-2847. 398p. Dep. NTIS $22.00.

Declassified 30 Aug 1973.

Refractory metal, fast reactors are capable of generating high temperature gas which may be used in rocket applications or in closed cycle gas turbine power plants. Some possible thrust control systems which are applicable to the nuclear powered rockets are considered. An analog computer was set up to represent the nuclear and aerothermal processes based upon lumped parameters. The stability of each control system was then investigated. Controller parameters were established in each case for a range of reactivity coefficients. Two different propellant pump characteristics were used. A high efficiency pump with a restricted operating region was compared with a low efficiency pump with a greater operating region. Centrifugal pumps designed for liquid hydrogen should have characteristics which are somewhere between these two extremes. Controller parameters do not change greatly when operating with different pumps. A fission product generator was simulated and used to study the shutdown and after-cooling of fast reactors. Because of the limited size of the computer facility, analytical approximations were introduced. Trends rather than absolute magnitudes were established during the computer study. (auth)

14854 (UNI-SA-4) VERIFICATION OF B_4C CONTENT IN REACTOR CONTROL RODS USING A ^{252}Cf SOURCE. Toffer, H.; Pursley, D. L. (United Nuclear Industries, Inc., Richland, Wash. (USA)). 27 Dec 1973. Contract AT(45-1)-1857. 9p. Dep. NTIS $3.00.

A 250 μg ^{252}Cf source was used in a neutron transmission experiment to measure the presence and density variation of B_4C in the Hanford N-Reactor control rods. This experiment was the final in a series of tests ascertaining the integrity and neutron absorption characteristics of the replacement control rods prior to their installation in the reactor. (auth)

14855 (XDC-59-1-105) ANALOG COMPUTER STUDY OF THE P-212 POWER PLANT CONTROL. Baker, J. K.; Gelhard, J. C. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). 1 Dec 1958. 56p. Dep. NTIS $5.00.

Declassified 17 Sep 1973.

An analog computer study was made of the P-212 power plant in order to determine its control characteristics. A description of the power plant, and the assumptions, basic equations, and methods used in developing the power plant control simulator are given with the resulting computer diagrams. Some typical results obtained using the simulator are included. (auth)

14856 REACTOR REFUELING METHOD. Frisch, E.; Andrews, H. N. (to Westinghouse Electric Corp.). US Patent 3,775,246. 27 Nov 1973. Filed Date 8 Jul 1970. 12p.

A nuclear reactor is disclosed wherein hydraulic drive mechanisms are provided to vary the location of a plurality of neutron absorbing control elements associated with selected fuel assemblies. Each fuel assembly comprises a fixed array of commingled and spaced fuel pins and guide tubes. Each selected assembly has a plurality of individually movable two-position control elements which are coupled to drive mechanisms which operate to telescope the control elements within their associated guide tubes. The control elements are situated such that they can be withdrawn into and removed with the upper support structure for refueling. (Official Gazette)

14857 USE OF COMPUTERS AND DATA PROCESSORS AT NUCLEAR POWER PLANTS AND ANALYSIS OF THE FUNCTIONS THEY CARRY OUT. Malyutin, Yu. M.; Kulikov, N. Ya. Therm. Eng. (USSR) (Engl. Transl.); 19: No. 8, 49-52(Aug 1972). Translated from Teploenergetika; 19: No. 8, 35-38(1972).

A description of the computerized data processing system for the Beloyarsk-1 Reactor is presented. Operational characteristics of the system are discussed. 6 references. (DCC)

14858 SIGNAL SEQUENCING SYSTEM. Wavre, A.; Santis, D. (to Westinghouse Electric Corp.). Canadian Patent 912,178. 10 Oct 1972. Priority date 13 Feb 1969, USA.

A system for controlling and sequencing the motion of control rods in a nuclear reactor is claimed. The rods are moved by jacks of well-known design, heretofore controlled by electromagnetic devices. The digital system described has the advantages of greater rapidity and easier manual override. The rods have to be moved in a cyclic manner, such that if the direction of motion is suddenly reversed, the first element (or bank of elements) to be moved is the last that was moved in the opposite direction previously. This is provided for by logical algorithms. (CA)

14859 ABSORPTION ROD FOR NUCLEAR REACTOR. Reinstein, D.; Gnutzmann, H. (to Brown Boveri Krupp Reaktorbau GmbH). German Patent 1,911,400. 24 Sep 1970. Filed date 6 Mar 1969. (In German).

An absorption rod is described for nuclear reactors which consists of a set of spherical elements into which the absorbing rod can be introduced freely. The end of the rod that enters the set presents one or more openings for receiving the spherical elements that terminate in one or more channels. The head of the rod is flexible and can be deflected. (TSS)

14860 CONTROL DRIVE FOR A SODIUM-COOLED NUCLEAR REACTOR CONTROL ROD. Kuenzel, H.; Pawlitski, R. (to Siemens AG). German Patent 1,816,287. 2 Jul 1970. Filed date 21 Dec 1968. (In German).

A control drive is described for the control rod for a sodium-cooled nuclear reactor with a pivoting cover consisting of a braced support and a motor device as well as an installation for the accelerated ejection of a control rod for emergency shutdowns. The control rod drive is characterized by parts for the movement of the control rod outside the reactor vessel which are exchangeable and which can be removed. An automatic uncoupling of the control rod as well as a withdrawal of the braced support located in the interior of the vessel can be accomplished. (TSS)

14861 DEVICE FOR THE REGULATION OF NUCLEAR REACTORS. Riemann, K. (to Siemens AG). German Patent 1,514,442. 18 Jun 1970. Filed date 14 Apr 1965. (In German).

A device is described for the regulation of nuclear reactors according to the principle of neutron absorption with spherical absorbing bodies moved by gravity, pneumatically, or hydraulically. The control device is characterized by the fact that at the interior of the active zone of the core of the reactor some blocking devices are provided to disperse the spherical control elements. (TSS)

14862 ELECTRIC SUPPLY FOR NUCLEAR PLANTS. Apelt, O.; Borst, A. (to Siemens AG). German Patent 1,907,176. 3 Sep 1970. Filed date 13 Feb 1969. (In German).

Electric supply for nuclear power plants for the placement of control rods is described. At the time that an order is received for the rapid shutdown of the reactor causing the control rods to penetrate the core and at the same time their own needs so far as current is concerned disappear, an important part of the energy accumulated in the battery of control rods is used briefly for driving the control rod mechanism. (TSS)

14863 EMERGENCY HYDRAULIC SHUTDOWN SYSTEM FOR NUCLEAR REACTORS. Acher, H. (to Licentia Patent Verwaltungs GmbH). German Patent 1,614,098. 29 Oct 1970. Filed date 24 Nov 1967. (In German).

An emergency hydraulic shutdown system for nuclear reactors is described. The control chamber is connected to the cooling chamber by a retention valve in such a way that where one back pressure chamber is opened to atmospheric pressure, in the case of an emergency, the coolant passes into the control chamber. A differential pressure valve operated by the coolant pressure opens the back pressure chamber. (TSS)

14864 CONTROL ROD FOR PEBBLE BED NUCLEAR REACTOR. Angelini, A.; Handel, H.; Landwfhr, H.; Schoening, J. (to Brown Boveri Krupp Reaktorbau GmbH). German Patent 1,815,916. 2 Jul 1970. Filed date 20 Dec 1968. (In German).

A control rod is described for regulation of a pebble bed nuclear reactor. The rod moves across the elements and is characterized by the fact that it is threaded so that it can perform a longitudinal movement or one of rotation. (TSS)

14865 NUCLEAR PLANT CONTROL DEVICE. Roeger, H. (to Licentia Patent Verwaltungs GmbH). German Patent 1,639,312. 4 Mar 1971. Filed date 9 Mar 1968. (In German).

A control device for a nuclear power plant composed of a boiling water reactor and a group of steam turbines where the radioactive steam produced in the reactor is led into the direct power cycle of the turbine is described. The control system is characterized by the fact that the valves for regulating the reactor pressure are arranged in the interior of the containment vessel or immediately outside the wall of the containment vessel. (TSS)

14866 LIQUID SAFETY RODS OPERATED BY GRAVITY. Agazzi, A.; Broggi, A.; Galli de Paratesi, S.; Ghiurghi, L. (to Commission of the Europea n Communities). Canadian Patent 902,274. 6 Jun 1972. Priority date 26 Oct 1967, Belgium.

An arrangement of liquid safety rods for a nuclear reactor is claimed. The arrangement includes several empty tubes intersecting the reactor vertically, and connected at their lower ends to at least one lower collector, and a lower reservoir of poison solution situated below the level of the lower collector and connected via a pump to an upper accumulator of poison situated above the level of the reactor. The upper accumulator is connected with the lower collector via a shut-off valve at the entrance to the latter. The lower collector is also connected via a valve to an accumulator overfilled with poison solution provided with an evacuating pipe beginning at a level just below that of the entry of the empty tubes into the reactor, and ending in the lower reservoir of poison solution, situated below it. (CA)

14867 FLUID CONTROL AND SAFETY RODS FOR NUCLEAR REACTORS. Agazzi, A.; Broggi, A.; Galli de Paratesi, S.; Ghiurghi, L. (to Commission of the European Communities). Canadian Patent 902,275. 6 Jun 1972. Priority date 5 Apr 1968, Belgium.

Vertical poison tubes in a reactor are used for control and emergency shutdown. For control, the tubes contain a poison gas, whose pressure is adjusted as required. At the bottom of the tubes, and below the level of the reactor core is a poison solution, which can be forced up into the tubes (preferably through the action of gravity) by the opening of a valve actuated by an emergency signal. (CA)

14868 ON-LINE NOISE ANALYSIS AND REACTOR PLANT OPERATION. Kemeny, L. G. (Univ. of New South Wales, Kensington, Australia). At. Energy Aust.; 16: No. 2, 25-30(Apr 1973).

A description is given of the operation of an on-line, real-time data acquisit ion computer developed by the School of Nuclear Engineering, University of New South Wales which is being interfaced with the Australian Atomic Energy Commission's HIFAR reactor in order to record, analyse, identify and ultimately to control such fluctuations and vibrations due to reactor plant noise sources. These investigations although carried out on HIFAR using both the SNEDAC and ISAC systems are being conducted in such a way as to make the experimental techniques and theoretical models developed relevant to any power situation. (AT)

14869 CONTROL OF NUCLEAR REACTORS. Harrington, E. L. E.; Duncombe, E. (to United Kingdom Atomic Energy Authority). US Patent 3,773,619. 20 Nov 1973. Priority date 30 May 1969, United Kingdom of Great Britain and Northern Ireland. 8p.

A control device chargeable as a unit into the core structure of a nuclear reactor comprises a reservoir and a receiver for a neutron absorbing liquid metal such as lithium 6. With the device located in the core structure of the reactor the receiver is located in the fuel zone of the core structure with the reservoir located above the receiver. A feed line for the lithium metal links the reservoir with the receiver and a flow coupler energized by flow of liquid metal reactor coolant is provided to inhibit the transfer of lithium from the reservoir to the receiver when the flow coupler is fully energized. Reduction of the degree of energization of the flow coupler due for example to a fall in the rate of flow of liquid metal reactor coolant through the flow coupler results in transfer of lithium from the reservoir into the receiver to shut down the reactor. The flow coupler is also adapted to return the lithium from the receiver to the reservoir through a return line when energized by return to full rate of flow of liquid metal reactor coolant through the flow coupler. (Official Gazette)

14870 SYNTHESIS PROGRAMMING AND AN APPLICATION TO OPTIMAL CONTROL-ROD PROGRAMMING. Kalimullah. Cincinnati; Univ. of Cincinnati (1973). 254p. University Microfilms Order No. 73-26,124.

Thesis (Ph.D.).

Starting from the basic concepts of calculus, a direct continuous and semianalytical method, Synthesis Programming, is developed

for obtaining approximate solutions of optimal control problems of both lumped and distributed systems without inequality constraints. A technique is developed for the elimination of control variables and, in some cases, also some of the state variables. Partial integral constraints, appearance of state variables in performance index, and nonlinear problems are also considered. The methods of synthesis programming are applied to solve six problems of optimal control-rod programming of a nuclear reactor described by the point kinetics model. The solutions obtained compare accurately with those obtained by the state space technique. The method is also applied to solve the problem of the flattest power density distribution of a bare finite-cylindrical PWR core. Four computer codes based on the methods of synthesis programming are also given. (Diss. Abstr. Int., B.)

14871 METHOD AND SYSTEM FOR OPERATING A BOILING WATER REACTOR–STEAM TURBINE PLANT PREFERABLY UNDER DIGITAL COMPUTER CONTROL. Giras, T. C.; Podolsky, L. B. US Patent 3,778,347. 11 Dec 1973. Filed date 27 Sep 1971. 20p.

A digital computer control system is described which operates a boiling water nuclear reactor and a steam turbine in an electric power plant. The computer applies feedforward control to the reactor system and to the turbine inlet and bypass steam valves to meet plant load demand within throttle pressure constraints. The plant is operated by the computer in the turbine follow mode or the coordinated mode. (Official Gazette)

14872 NUCLEAR REACTOR CONTROL ROD DRIVES. Daublebsky, P.; Zeitzschel, G. (to Licentia, Patent-Verwaltungs GmbH). US Patent 3,779,134. 18 Dec 1973. Priority Date 6 Jun 1970, F. R. Germany. 8p.

A control rod drive for nuclear reactors is described in which the drive is actuated through a pressure medium that acts against a control piston associated with the rod and has a locking device which includes relatively movable latches that can be selectively engaged in detents in a guide tube for the piston. A second control piston is carried in axially spaced relationship to the control piston within the guide tube and has the same type of locking device. Means are provided within the guide tube to operatively interconnect the locking devices of the two control pistons in a sequential manner and to ensure that, during a movement of the drive in a direction to withdraw the control rod from the reactor, the latches of one locking device are engaged in an associated detent during a movement of the control piston carrying the other locking device and this locking device is not disengaged until the latches of the other locking device are engaged in another detent. (Official Gazette)

14873 DEVICE FOR ENGAGING AND DISENGAGING PINION AND RACK IN DRIVE OF NUCLEAR REACTOR REGULATING ELEMENT. Maslenok, B. A.; Zlobin, V. G.; Khegai, A. S.; Kolpino, V. P. N.; Krjuger, E. A. US Patent 3,778,345. 11 Dec 1973. Filed Date 31 Mar 1972. 4p.

The invention relates to a device for engaging and disengaging the pinion and rack in the drive of a nuclear reactor regulating element. The device according to the invention is characterized in that the electromagnet which engages the pinion with, and disengages it from, the rack is installed coaxially with the rack axis whereas the swinging balance arm carrying the pinion is connected with the electromagnet core by articulated rods set at an acute angle to the rack axis. This simplifies the drive of the regulating element, reduces the lateral dimensions of the drive and cuts down the time elapsing from the moment of receiving the signal for the movement of the regulating element in the reactor zone to the beginning of its movement both under the regulating and emergency protection conditions. (Official Gazette)

14874 NEW BWR CONTROL CENTER SMALLER AND SIMPLE, MORE POWERFUL. Johnson, R. L. Jr. Power Eng.; 77: No. 12, 48-50(Dec 1973).

The development of nuclear power plant control systems which are compact (half the size of previous systems), factory-fabricated modules engineered to the operator's exact needs is discussed. Control room designs for use in the 1980's are described. Computer-driven cathode ray tube displays and miniaturized devices are used to present information to the operator in a form that is easier to understand and analyze. Biotechnology is incorporated in the designs to reduce the number of devices confronting the operator, which in turn improves the operator response time and reduces human errors. (LCL)

14875 CONTROL-ROD ASSEMBLY FOR NUCLEAR REACTORS. Marmonier, P.; Plufgrad, K. (to Commissariat a l'Energie Atomique). US Patent 3,773,617. 20 Nov 1973. Priority Date 22 Dec 1970, France. 4p.

An assembly comprising a stationary thimble and a control rod having a neutron-absorbing portion is displaceable vertically between a bottom position in which the absorbing portion is placed within the reactor core and a top position in which it is placed outside the core. The thimble is provided both beneath and above the reactor core with apertures for the admission and discharge of coolant and with a control-rod guide bearing located above the level of the reactor core. The clearance left by the bearing between the control rod and the thimble is sufficiently small to ensure that the coolant flow between these latter is a small fraction of the flow which passes through the neutron-absorbing portion. (Official Gazette)

14876 CONTROL ROD DRIVE FOR A WATER-COOLED NUCLEAR REACTOR. Ode, B.; Suvanto, Z.; Tornblom, L. (to AB Asea-Atom). US Patent 3,775,247. 27 Nov 1973. Priority Date 18 Jun 1970, Sweden. 6p.

A control rod drive for a water-cooled nuclear reactor includes a double-walled cylinder with an opening at the bottom from the space between the walls into the interior. A piston slidable in the interior is connected to the control rod. A motor driven spindle carries a nut which can be moved upwardly into engagement with the piston to raise the control rod for normal control purposes. A source of gas under pressure is connected through a scram valve to the top of the space between the walls, for pressing water into the cylinder to raise the piston and control rod quickly in an emergency. (Official Gazette)

Nuclear Power Plant Economics

Refer also to abstract 12955.

14877 (BARC/I-176, pp 188-205) OPTIMIZATION OF REACTOR SYSTEM COMBINATIONS. Balakrishnan, M. R. (Bhabha Atomic Research Centre, Bombay). 1972.

A set of equations is developed, which presents the condition for the generation of nuclear power with the lowest expenditure. Constraints imposing limitations on the total availability of nuclear materials are formulated. Various types of nuclear reactor systems are considered and the fuel cycle costs of these reactor systems over the entire planning period are estimated in detail. Growth of the total installed nuclear capacity over the planning period is assumed to be known. (auth)

14878 REVIEW OF NUCLEAR AGRO-INDUSTRIAL COMPLEXES WITH SPECIAL REFERENCE TO INDIA. Thomas, K. T. (Bhabha Atomic Research Centre, Trombay, India). At. Energy Rev.; 11: No. 2, 239-304(1973).

The concept of "energy centres" based on the optimum use of energy produced around its production source is not new. However, the production and use of low cost power and water from large nuclear single- or dual-purpose plants is a subject that has been looked into in detail only during the last few years. Most of the major studies had been completed and reported on by the end of 1971. Since then these studies have not been pursued as vigorously as formerly, probably due to the upward trend of nuclear power generation costs over the last few years. However, the continuing research and development work in the fields of nuclear power, especially on breeder reactors, desalination, phosphorus production, electrolysis etc., and the management expertise now available for the integrated development of industries, institutions, agriculture and the socio-economic environment are expected to soon show that it is possible to develop large areas, especially arid regions, economically through the application of this concept. This would particularly apply to developing countries that have a strong nuclear base like India, where agriculture is mostly dependent on the monsoon. The review, though confined more specifically to India, is intended to provide source material for others interested in the subject. (auth)

14879 NUCLEAR COMPONENTS. Pawliw, J. (Canadian General Electric Co. Ltd., Toronto). pp vp of Proceedings of the 1972 Annual Conference of the Canadian Nuclear Association, Chalk River, Ont.; Atomic Energy of Canada Ltd. (1972).

From Canadian Nuclear Association 1972 annual conference; Ottawa, Ontario (11 Jun 1972). Paper No. 72-CNA-202.

Projections of nuclear generating capacity growth in Canada and the corresponding projections of utility expenditures in the nuclear industry (usually expressed in millions of dollars) are quite commonplace. This expenditure, however, is shared by many suppliers, and it is interesting to review just what it means to the individual suppliers. It is approximately seven years from station commitment to the in-service date of the first unit in a multiunit station. During this period the activity in a shop supplying nuclear components to the station may peak for only a matter of months. This peak period will be straddled by perhaps two years of significantly lesser activity and the remaining

years will see no activity whatsoever. Some of the nuclear components require specialized technologies, expertise, and equipment, and some of the major components make up a large fraction of the relevant shop loading during the peak period. In such instances intermittent peak/valley shop loading presents a considerable hardship. This hardship will be alleviated when the frequency of nuclear station installations is sufficiently high that the manufacturing activities associated with consecutive stations overlap, forming a smoother or wave-like pattern, rather than the current peak/valley pattern. For some of the nuclear components this highly desirable situation is not expected to materialize until well into the eighties. The situation is further aggravated when the supply of like components is shared by more than one supplier. In this instance, the supplier will have to wait even longer to experience a measure of continuity in his nuclear component business. Because of the increasing size of nuclear installations, because of the importance of the quality and reliability of the components making up these installations, and because of the resultant need for a strong, competent, and reliable nuclear industry, there is an ever increasing need for greater integration and co-operation in long-term planning by the customer, the suppliers and the government. (CA)

14880 CONVENTIONAL COMPONENTS CAPABILITY REVIEW: CANADA '72. Wood, R. M. (Babcock and Wilcox Canada Ltd., Toronto). pp vp of Proceedings of the 1972 Annual Conference of the Canadian Nuclear Association. Chalk River, Ont.; Atomic Energy of Canada Ltd. (1972).

Canadian manufacturers of conventional components for the nuclear industry are establishing an enviable record of performance in the supply of equipment to nuclear standards. An understanding of the requirements of the relatively new industry is developing, to the extent that a depth of engineering knowledge and manufacturing competence is being achieved. Manufacturers of such components as heat exchangers, condensers, transformers, pumps and valves are achieving a high degree of capability and quality assurance, which is establishing Canada as a world leader in the production of components to nuclear standards. Many firms have acquired "N" stamp recognition and are making equipment to full nuclear requirements of the A.S.T.M., A.S.M.E., C.N.A. and other rigid world nuclear standards. Many Canadian firms have accumulated knowledge from other arms of their world-wide organizations and, in turn, have shipped Canadian-made components to many other countries. However, the future role of Canadian manufacturers in a relatively small and sporadic domestic market and largely untapped overseas market is a matter of concern that warrants intensive investigation and collective action by appropriate industry and government groups. (auth)

14881 ENERGY AND ECONOMIC CHARACTERISTICS TO BE EXPECTED AT NUCLEAR HEATING POWER PLANTS. Buki, G. Energ. Atomtech.; 25: No. 10, 477-486 (Oct 1972). (In Hungarian).

In this study the formation of condensation heating blocks to be expected at nuclear heating power plants is outlined. Energy characteristics to be expected from nuclear district heating are compared with the characteristics of an up-to-day conventional district heating. It is stated that operation costs of direct nuclear heat generation as well as nuclear heat generation combined with electricity generation can compete against district heating based on fossil fuels. Competition is going to increase with an increase of nuclear power plants. Alteration of investment costs due to the size of the nuclear heating power plant was investigated. (auth)

14882 YEARBOOK 1973 OF THE ATOMWIRTSCHAFT. Mueller, W. D.; Hossner, R. (eds.). Duesseldorf; Handelsblatt (1973). 312p. (In German).

The review articles in the first part of this yearbook deal with a number of general subjects such as the present status and future development of nuclear power plants, the utilization of of process heat and the currently available nuclear fuels. The second part of the yearbook contains all the news and information printed in the various issues of the 1972 volume of "Atomwirtschaft", grouped according to countries and subjects. The third part gives economic and technical data relating to nuclear power plants in particular as well as to the entire field of the development of nuclear energy (e.g. public expenditure for nuclear energy, fuel cycle, utilization of radioactive substances, nuclear safety and environmental protection). (GE)

14883 CANDU FUEL: AN INDUSTRY PERSPECTIVE. Tough, D. E. (Westinghouse Canada Ltd., Hamilton, Ont.). pp vp of Proceedings of the 1972 Annual Conference of the Canadian Nuclear Association. Chalk River, Ont.; Atomic Energy of Canada Ltd. (1972).

From Canadian Nuclear Association 1972 annual conference; Ottawa, Ontario (11 Jun 1972). Paper No. 72-CNA-201.

The economics of the nuclear fuel industry in Canada are discussed in terms of past achievements, present status and future possibilities. To manufacture the fuel for Bruce Nuclear Power Station, Canadian production facilities must be increased by a factor of 3 by 1975 and by a factor of 5 by 1980. The present maximum production rate in the USA is approximately 2000 to 2500 tonnes per year compared with approximately 300 tonnes in Canada. Mention of past problems solved includes, corrosion of Zircaloy, grain growth of uranium dioxide, deposition of scale, fretting, wear of pressure tubes, heat transfer between uranium dioxide and cladding, and surface boiling. More work must be done to reduce the incidence of fuel defects. Further long-term reduction of fuelling costs might be derived from increased power rating of the elements, increased length of bundles, adoption of uranium silicide, plutonium or ^{235}U enrichment, or $^{233}U/ThO_2$. (CS)

14884 TECHNICAL AND ECONOMICAL ASPECTS OF ELECTRICITY GENERATION BY NUCLEAR POWER. Eitz, A. M. (Rheinisch-Westfaelisches Elektrizitaetswerk AG, Essen). (1973). vp. (In German).

From meeting of the German Chemistry Society on energy, budget, and electrical heat; Ludwigshafen, Ger. (4 Oct 1973).

Based on an estimate of the primary energy demand, the share for the generation of electricity, as well as the share of nuclear energy in generating electricity for the FRG until 1985, the most important trends in the development of nuclear energy are discussed. Amongst the part problems dealt with, especially problems of economy, covering of the demand of uranium, as well as of the development of advanced reactors are gone into. (GE)

14885 REVIEW OF ONTARIO HYDRO'S NUCLEAR PROGRAM AND EXPERIENCE. Woodhead, L. W. (Hydro-Electric Power Commission of Ontario, Toronto). pp vp of Proceedings of the 1972 Annual Conference of the Canadian Nuclear Association. Chalk River, Ont.; Atomic Energy of Canada Ltd. (1972).

From Canadian Nuclear Association 1972 annual conference; Ottawa, Ontario (11 Jun 1972). Paper No. 72-CNA-303.

Ontario Hydro's nuclear-electric program, in co-operation with Atomic Energy of Canada Limited, consists of four stations, comprising ten units, with an ultimate capacity of nearly 5300 MW(e) net. In addition, Ontario Hydro is commissioning and will operate the 800 Mg/a Bruce Heavy Water Plant on behalf of AECL. NPD, the small pilot plant, has operated very well for ten years, while serving as an invaluable manpower development and experimental facility. Performance of Douglas Point, the prototype plant, has been disappointing but not unexpected. Neither production reliability nor heavy-water upkeep costs would be acceptable for commercial units. However, reliability has been improving steadily, and with perseverance it can become satisfactory. On the credit side, Douglas Point has been and is a "knowledge generator", largely responsible for the superb early performance at Pickering. Pickering, the first commercial design, is evidence that we are on the steep part of the "learning curve" and that we are climbing it. NPD, Douglas Point, and Pickering have confirmed the predicted extremely low fuelling costs of less than 1.0 $/MWh, with reliable on-power re-fuelling. In the first 13 unit-months of full power operation, Pickering-1 and Pickering-2 have averaged over 80% net capacity factor, and heavy-water upkeep costs are currently about 0.12 $/MWh. This evolution is very encouraging. Nevertheless, several major criteria remain to be demonstrated or guaranteed. Until these are known, the real relative economics of Pickering, Bruce, and future "family" units can only be predicted within a range of uncertainties. Comparable or greater uncertainties face all of the competing nuclear concepts. (auth)

Reactor Fuel Cycle Economics

Refer also to abstract 14613.

14886 (BARC/I-176, pp 163-172) REACTOR FUEL MANAGEMENT. Subramanian, T. A. (Bhabha Atomic Research Centre, Bombay). 1972.

Since an efficient fuel utilization leads to savings in both capital and fuel cycle cost and thereby a reduced unit energy cost, the subject of fuel management in nuclear power reactors is reviewed. The techniques and physical problems associated with fuel management are discussed. The different types of practical fueling schemes are described and their relative merits and demerits pointed out. The various computer codes that have been used in the case of reactors like the one at Rajasthan are mentioned. (INIS)

14887 (BARC/I-190, pp 78-102) PHYSICS OF PLUTONIUM AS A THERMAL REACTOR FUEL. Bhatia, H. K. (Bhabha Atomic Research Centre, Bombay). 1972.

The use of plutonium, which would be available from thermal reactors such as the ones at Rajasthan and Tarapur in India, was discussed from the point of view of the economic considerations involved. Plutonium could either be recycled in thermal reactors or be stored for future use in fast breeder reactors. The physics problems resulting from the utilization of plutonium in thermal reactor are discussed in detail. The basic resonance and cross section data, the delayed neutron fraction, the energy per fission and the fission products are presented in the form of tables. Plutonium design parameters, their differences relative to uranium parameters, theoretical correlation of different parameters, power distribution correlation, the effect of ^{241}Pu decay on the analysis of plutonium critical experiments, different uses of plutonium, and the fueling schemes, are described in detail. (INIS)

14888 (HEDL-SA-666) MODEL FOR CALCULATING THE INCREMENTAL FUEL COST OF REACTOR OPERATING STRATEGIES. Omberg, R. P. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 1973. 26p. (CONF-740102-1). Dep. NTIS $3.50.

From nuclear utilities planning methods symposium; Chattanooga, Tennessee, USA (16 Jan 1974).

A code has been developed to calculate incremental nuclear fuel costs. The code performs multi-cycle reactor calculations with the fuel charged, shuffled, and discharged between cycles. Upon examining sample problems with this code, it has been found that coupling effects between cycles influence incremental costs. In fact, calculating incremental costs by considering expenses and credits associated only with the perturbed cycle can often be misleading. (19 references) (auth)

14889 UTILITIES COMPUTER CODE REQUIREMENTS FOR IN-REACTOR FUEL MANAGEMENT. Ariemma, A.; Paoletti Gualandi, M.; Zaffiro, B. (ENEL, Rome). Newslett. ENEA Comput. Programme Libr.; No. 15, 37-59(Nov 1973).

Some considerations on various aspects of core and fuel management that a utility should follow closely and directly are presented. The main areas of in-reactor fuel management are briefly described together with the requirements for in-house calculation techniques commented in the light of the experience of about ten years of operation of ENEL nuclear stations and supplemented by predictions on the requirements of future nuclear programs. 16 programs. (auth)

14890 DIRECTIONS OF EFFICIENT UTILIZATION OF NUCLEAR FUEL BY ATOMIC POWER INDUSTRY WITH FAST REACTORS. Leipunskii, A. I.; Orlov, V. V.; Lytkin, V. B.; Troyanov, M. F.; Yrova, L. N. Kernenergie; 16: No. 1, 1-8 (Jan 1973). (In German).

Starting from the limited resources of natural uranium and continuously increasing power requirements, reactor strategies based on pressurized-water and fast reactors with uranium requirements that are as low as possible are pointed out. Parameters already attained and those expected for these reactors in the future were taken as a basis. The versions of fast breeder core layout determined by use of a complex program of optimization are elucidated. Efficiency characteristics for utilization of uranium were derived from increasing uranium cost and additional requirements for uranium. (auth)

14891 LINEAR PROGRAMMING MODEL FOR THE MINIMUM COST REFUELING OF A NUCLEAR REACTOR. Brown, M. L. Manhattan, KS; Kansas State Univ. (1973). 117p. University Microfilms Order No. 73-26,335.

Thesis (Ph. D.).

A linear reactor model is developed to demonstrate a technique that uses linear programming to determine the optimum refueling-shuffling pattern that minimizes the refueling costs for each operating period of a nuclear reactor. This development is presented with the purpose in mind that this linear reactor model can be easily adapted to any particular nuclear reactor. The reactor linearization is achieved by the assumption that the flux spatial distribution is a constant for any given operating period. The reactor core is divided into concentric annular zones and the compositional state of the fuel is described by burnup or enrichment groups. The decision variables describe the number of fuel elements of a given composition that is moved from one zone to another during the refueling. New and removed fuel elements are included in this description. Constraints involving material balances, neutronic requirements, thermal hydraulic limitations, and scheduling are used to assure a realistic model. The linear reactor model is applied to a 1000 MW(e) PWR as an example. The linear programming solution of the model results in an average savings of 9% as compared to an "out-in" model. The effects of varying the number of enrichments available, of different period lengths, and of various local reactivity distributions are investigated. Proper manipulation of these factors can result in refueling cost savings. (Diss. Abstr. Int., B)

14892 MODEL FOR CALCULATING THE NUCLEAR FUEL CYCLE OF ONE POWER REACTOR. Mueller, A. (VEB Kombinat Kraftwerksanlagenbau, Berlin). Kernenergie; 16: No. 9, 270-273 (Sep 1973). (In German).

The principal features of a programme allowing the calculation of the long-term behavior of a nuclear fuel system with one reactor only are presented. In order to evade high costs of calculation, the reactor behavior is calculated with given neutron flux distributions and cross-sections; in other respects, the time-dependent processes (balances of amounts) in the system, as e.g., loading, reloading, discharging, intermediate storage, cooling, reprocessing, refabrication etc., are taken into account in a rather detailed, extended, and variable manner. The model allows the calculation of the long-term behavior of the nuclear fuel system with and without recycling of the spent nuclear fuel for various régimes, e.g., steady-state operation, various transient régimes, fluctuating or irregular régimes, running-down behavior after reactor shutdown, with feeding-in nuclear fuel from other systems, with forced removal of reprocessed fuel, with recharging of fuel elements lowly burnt up, etc. (auth)

14893 ENERGY CRISIS AND THE NUCLEAR FUEL CYCLE. Forscher, F. Nucl. Mater. Manage.; 11: No. 3, 3-10(Fal 1973).

From proceedings of the 14th annual meeting of the Institute of Nuclear Materials Management, Inc.; San Diego, CA (20 Jun 1973).

Reactor Licensing and Regulation

Refer also to abstract 12695.

14894 (DOCKET-50155-184) BIG ROCK POINT NUCLEAR PLANT. Unusual Event: Discrepancy in Recirculating Pump Discharge Valve Travel Time. (Consumers Power Co., Jackson, Mich. (USA)). 6 Dec 1973. 2p. Dep. NTIS $3.00.

14895 (DOCKET-50213-253) HADDAM NECK PLANT. Abnormal Occurrence Preliminary Report No. AO 73-12: Steam Generator Holddown Bolt Failure. (Connecticut Yankee Atomic Power Co., Hartford (USA)). 7 Dec 1973. 9p. Dep. NTIS $3.00.

14896 (DOCKET-50213-254) HADDAM NECK PLANT. Abnormal Occurrence Report No. AO-73-12: Additional Steam Generator Holddown Bolt Failure. (Connecticut Yankee Atomic Power Co., Hartford (USA)). 7 Dec 1973. 2p. Dep. NTIS $3.00.

14897 (DOCKET-50219-356) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Summary Report on Main Steam Isolation Valve Inspection and Repair. (Jersey Central Power and Light Co., Morristown, N. J. (USA)). 7 Dec 1973. 3p. Dep. NTIS $3.00.

14898 (DOCKET-50220-196) NINE MILE POINT NUCLEAR STATION, UNIT 1. Report on Operation When a Loss of Incoming 115 kV Occurred. (Niagara Mohawk Power Corp., Syracuse, N.Y. (USA)). 21 Nov 1973. 2p. Dep. NTIS $3.00.

14899 (DOCKET-50220-202) NINE MILE POINT NUCLEAR STATION, UNIT 1. Unusual Event Report No. 73-11-2: Discrepancy in the Pressure Set Point Trip of the Recirculation Pumps for the Analysis of Transients Without Scram. (Niagara Mohawk Power Corp., Syracuse, N. Y. (USA)). 30 Nov 1973. 2p. Dep. NTIS $3.00.

14900 (DOCKET-50220-203) NINE MILE POINT NUCLEAR STATION, UNIT 1. Abnormal Occurrence Report No. 73-11-29: Fifteen Control Rod Drives Failed to Insert to Position 00 Following a Reactor Scram. (Niagara Mohawk Power Corp., Syracuse, N. Y. (USA)). 3 Dec 1973. 1p. Dep. NTIS $3.00.

14901 (DOCKET-50220-206) NINE MILE POINT NUCLEAR STATION, UNIT 1. Abnormal Occurrence: Failure of a Magnetrol Switch No. 352624 in the Scram Dump Volume Level System. (Niagara Mohawk Power Corp., Syracuse, N. Y. (USA)). 10 Dec 1973. 2p. Dep. NTIS $3.00.

14902 (DOCKET-50220-211) NINE MILE POINT NUCLEAR STATION, UNIT 1. Abnormal Occurrence: Additional Information re Failure of Control Rods to Insert to 00 Following a Reactor Scram. (Niagara Mohawk Power Corp., Syracuse, N. Y. (USA)). 21 Dec 1973. 4p. Dep. NTIS $3.00.

14903 (DOCKET-50237-433) DRESDEN NUCLEAR POWER STATION, UNIT 2. Abnormal Occurrence: Torus High Water

Level. (Commonwealth Edison Co., Chicago, Ill. (USA)). 30 Nov 1973. 2p. Dep. NTIS $3.00.

14904 (DOCKET-50237-434) DRESDEN NUCLEAR POWER STATION, UNIT 2. Abnormal Occurrence Report: Failure of Main Steam Line Drain Valve MO-2-220-2 to Operate. (Commonwealth Edison Co., Chicago, Ill. (USA)). 6 Dec 1973. 2p. Dep. NTIS $3.00.

14905 (DOCKET-50244-226) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Abnormal Occurrence Report No. 73-11: Motor-Driven Feedwater Pumps A and B Were Found to be Air Bound and Would Not Pump. (Rochester Gas and Electric Corp., N. Y. (USA)). 21 Dec 1973. 4p. Dep. NTIS $3.00.

14906 (DOCKET-50245-321) MILLSTONE NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence Report No. AO-73-12: Leakage Was Observed from the Isolation Condenser Tube Nest Boundary Flange. (Millstone Point Co., Hartford, Conn. (USA)). 31 Dec 1973. 1p. Dep. NTIS $3.00.

14907 (DOCKET-50247-164) INDIAN POINT STATION, UNIT 2. Abnormal Occurrence Report No. AO-3-2-16: The Setting for One of the Three Bistables Associated With Low Pressurizer Pressure Safety Injection Was Below Specifications. (Consolidated Edison Co. of New York, Inc., New York (USA)). 19 Nov 1973. 1p. Dep. NTIS $3.00.

14908 (DOCKET-50247-167) INDIAN POINT STATION, UNIT 2. Abnormal Occurrence Report No. AO 3-2-15: Leaks Were Observed at the $^{3}/_{4}$ Inch Pipe to Socket Weld Branch Connections for Vent Valves S-47 and S-51 Associated With the RHS System. (Consolidated Edison Co. of New York, Inc., New York (USA)). 31 Oct 1973. 1p. Dep. NTIS $3.00.

14909 (DOCKET-50247-168) INDIAN POINT STATION, UNIT 2. Abnormal Occurrence Report No. AO 3-2-16: Erroneous Setting on a Bistable Associated With Low Pressurizer Pressure Safety Injection. (Consolidated Edison Co. of New York, Inc., New York (USA)). 3 Dec 1973. 1p. Dep. NTIS $3.00.

14910 (DOCKET-50247-172) INDIAN POINT STATION, UNIT 2. Abnormal Occurrence Report No. AO-3-2-18: Malfunction of a Bistable Associated With Low Pressurizer Pressure Safety Injection. (Consolidated Edison Co. of New York, Inc., New York (USA)). 21 Dec 1973. 2p. Dep. NTIS $3.00.

14911 (DOCKET-50247-173) INDIAN POINT STATION, UNIT 2. Abnormal Occurrence: A Turbine Trip Resulted in the Shutdown of the In-Service No. 21 Main Boiler Feed Pump and in a Reactor Trip. (Consolidated Edison Co. of New York, Inc., New York (USA)). 30 Nov 1973. 9p. Dep. NTIS $3.00.

14912 (DOCKET-50247-174) INDIAN POINT STATION, UNIT 2. Abnormal Occurrence Report No. 3-2-17: Malfunction of Bistable Devices. (Consolidated Edison Co. of New York, Inc., New York (USA)). 18 Dec 1973. 2p. Dep. NTIS $3.00.

14913 (DOCKET-50247-176) INDIAN POINT STATION, UNIT 2. Abnormal Occurrence Report No. AO-3-2-17: Malfunction of a Bistable Associated With High Pressurizer Level Reactor Trip. (Consolidated Edison Co. of New York, Inc., New York (USA)). 28 Dec 1973. 2p. Dep. NTIS $3.00.

14914 (DOCKET-50247-177) INDIAN POINT STATION, UNIT 2. Incident Report on Turbine Trip and Reactor Trip, Supplemental Information. (Consolidated Edison Co. of New York, Inc., New York (USA)). 30 Nov 1973. 9p. Dep. NTIS $3.00.

14915 (DOCKET-50249-328) DRESDEN NUCLEAR POWER STATION, UNIT 3. Abnormal Occurrence Report: Failure of Reactor Cleanup System Valve MO-3-1201-2 to Operate. (Commonwealth Edison Co., Chicago, Ill. (USA)). 6 Dec 1973. 2p. Dep. NTIS $3.00.

14916 (DOCKET-50249-332) DRESDEN NUCLEAR POWER STATION, UNIT 3. Unusual Event: Primary Containment Isolation Valve Leakage. (Commonwealth Edison Co., Morris, Ill. (USA)). 19 Dec 1973. 2p. Dep. NTIS $3.00.

14917 (DOCKET-50249-333) DRESDEN NUCLEAR POWER STATION, UNIT 3. Abnormal Occurrence: Diesel Generator Cooling Water Pump Trip. (Commonwealth Edison Co., Chicago, Ill. (USA)). 21 Dec 1973. 2p. Dep. NTIS $3.00.

14918 (DOCKET-50249-336) DRESDEN NUCLEAR POWER STATION, UNIT 3. Unusual Event: Malfunction of High Pressure Coolant Injection High Flow Switch. (Commonwealth Edison Co., Chicago, Ill. (USA)). 27 Dec 1973. 2p. Dep. NTIS $3.00.

14919 (DOCKET-50251-172) TURKEY POINT PLANT, UNIT 4. Abnormal Occurrence Report No. AO-4-73-13: 4B Sequences Timer Clutch Coil Failure. (Florida Power and Light Co. (USA)). 7 Dec 1973. 2p. Dep. NTIS $3.00.

14920 (DOCKET-50254-295) QUAD-CITIES STATION, UNIT 1. Abnormal Occurrence: The Setpoint of Three Primary Containment Isolation System Instruments Drifted. (Commonwealth Edison Co., Cordova, Ill. (USA)). 19 Nov 1973. 3p. Dep. NTIS $3.00.

14921 (DOCKET-50254-303) QUAD-CITIES STATION, UNITS 1 AND 2. Report on Inspections of Ohio Injector Company Valves. (Commonwealth Edison Co., Cordova, Ill. (USA)). 28 Dec 1973. 2p. (DOCKET-50265-287). Dep. NTIS $3.00.

14922 (DOCKET-50255-210) PALISADES NUCLEAR PLANT. Abnormal Occurrence Report: Gaseous ^{131}I Release Rate Limits Were Exceeded. (Consumers Power Co., Jackson, Mich. (USA)). 10 Dec 1973. 3p. Dep. NTIS $3.00.

14923 (DOCKET-50255-212) PALISADES NUCLEAR PLANT. Updated Results on Excessive Release of Radioiodine via the Plant Stack. (Consumers Power Co., Jackson, Mich. (USA)). 13 Dec 1973. 2p. Dep. NTIS $3.00.

14924 (DOCKET-50259-229) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence Report BFAO-7333W: Reactor Protection System Reactor Water Level Switch Malfunction. (Tennessee Valley Authority, Chattanooga (USA)). 16 Nov 1973. 3p. Dep. NTIS $3.00.

14925 (DOCKET-50259-258) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Environmental Abnormal Occurrence Report BF EAO-7364W Through 7370W: Fish Impingement Estimates. (Tennessee Valley Authority, Chattanooga (USA)). 7 Dec 1973. 2p. Dep. NTIS $3.00.

14926 (DOCKET-50259-259) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence Report BFAO-7344W: Malfunction of Main Steamline High-Flow Pressure Switch. (Tennessee Valley Authority, Chattanooga (USA)). 7 Dec 1973. 2p. Dep. NTIS $3.00.

14927 (DOCKET-50259-261) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence Report BFAO-7345W: Malfunction of Core Spray Sparger to Reactor Pressure Vessel Alarm d/p Switches. (Tennessee Valley Authority, Chattanooga (USA)). 10 Dec 1973. 2p. Dep. NTIS $3.00.

14928 (DOCKET-50259-263) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Environmental Occurrence Report BF EAO-7378W Through 7380W: Fish Impingement Estimates. (Tennessee Valley Authority, Chattanooga (USA)). 20 Dec 1973. 2p. Dep. NTIS $3.00.

14929 (DOCKET-50259-264) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Environmental Abnormal Occurrence Report BF EAO-7381W and 7384W: Fish Impingement Estimates. Mailgrams and Telegram. (Tennessee Valley Authority, Chattanooga (USA)). 28 Dec 1973. 5p. Dep. NTIS $3.00.

14930 (DOCKET-50259-269) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Environmental Abnormal Occurrence Report BF EAO-7378W Through 7380W: Fish Impingement Estimates. (Tennessee Valley Authority, Chattanooga (USA)). 20 Dec 1973. 2p. Dep. NTIS $3.00.

14931 (DOCKET-50259-270) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Environmental Abnormal Occurrence Report BF EAO-7371W: Fish Impingement Estimates. (Tennessee Valley Authority, Chattanooga (USA)). 19 Dec 1973. 3p. Dep. NTIS $3.00.

14932 (DOCKET-50259-271) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence Report BFAO-7347W: Standby Emergency Diesel Generator Failure to Start an Emergency Core Cooling Pump. (Tennessee Valley Authority, Chattanooga (USA)). 28 Dec 1973. 3p. Dep. NTIS $3.00.

14933 (DOCKET-50259-273) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence Report No. BFAO-7346W: Recirculation Pump A d/p Indication Switch Malfunction. (Tennessee Valley Authority, Chattanooga (USA)). 14 Dec 1973. 2p. Dep. NTIS $3.00.

14934 (DOCKET-50259-274) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence Report No. BFAO-7343W: Interim Report on Testing and Corrective Work Performed to Alleviate the Vibration Problem in the Torus and Torus-Ring Header. (Tennessee Valley Authority, Chattanooga (USA)). 17 Dec 1973. 2p. Dep. NTIS $3.00.

14935 (DOCKET-50259-277) BROWNS FERRY NUCLEAR POWER STATION, UNITS 1, 2, AND 3. Environmental Radioactivity Levels, Semiannual Report, January-June 1973. (Tennessee Valley Authority, Chattanooga (USA)). 27 Dec 1973. 34p. (DOCKET-50260-136; DOCKET-50296-122). Dep. NTIS $3.75.

14936 (DOCKET 50260-140) BROWNS FERRY NUCLEAR POWER STATION, UNITS 2 AND 3. Interim Report on HPCI and RCIC Control Logic Problem. Sequoyah Nuclear Plant, Units 1 and 2. Interim Report No. 2 on Potential Design Deficiency in the Interior Concrete Structure of the Reactor Building. (Tennessee Valley Authority, Chattanooga (USA)). 14 Dec 1973. 9p. (DOCKET-50296-124; DOCKET-50327-63; DOCKET-50328-56). Dep. NTIS $3.00.

14937 (DOCKET-50261-290) H. B. ROBINSON PLANT, UNIT 2. Abnormal Occurrence Report No. AO 73-71: Malfunction of Valve AFW V2-16C. (Carolina Power and Light Co., Raleigh, N. C. (USA)). 27 Dec 1973. 4p. Dep. NTIS $3.00.

14938 (DOCKET-50261-291) H. B. ROBINSON PLANT, UNIT 2. Abnormal Occurrence: Boric Acid Transfer Pump Shaft Failure. (Carolina Power and Light Co., Raleigh, N. C. (USA)). 31 Dec 1973. 2p. Dep. NTIS $3.00.

14939 (DOCKET-50261-294) H. B. ROBINSON PLANT, UNIT 2. Report re the Discovery of Several Sections of a Fuel Assembly Grid Clip in Steam Generator C. (Carolina Power and Light Co., Raleigh, N. C. (USA)). 27 Dec 1973. 4p. Dep. NTIS $3.00.

14940 (DOCKET-50263-279) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Lubricating Oil in the No. 12 Standby Liquid Control Pump Crankcase Was Found to be Contaminated With Sodium Pentaborate Solution. (Northern States Power Co., Minneapolis, Minn. (USA)). 1973. 1p. Dep. NTIS $3.00.

14941 (DOCKET-50263-287) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Abnormal Occurrence: Inoperability of No. 2 Starting System of the No. 12 Diesel Generator. (Northern States Power Co., Minneapolis, Minn. (USA)). 27 Dec 1973. 2p. Dep. NTIS $3.00.

14942 (DOCKET-50263-288) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Unusual Event: No. 12 Diesel Generator Would Not Start due to Sticking of the No. 2. Starting System Air Relay Valve. (Northern States Power Co., Minneapolis, Minn. (USA)). 17 Dec 1973. 1p. Dep. NTIS $3.00.

14943 (DOCKET-50265-284) QUAD-CITIES STATION, UNIT 2. Abnormal Occurrence: The 2B Recirculation Pump Tripped Due to Failure of an MG Set Oil Pump. (Commonwealth Edison Co., Cordova, Ill. (USA)). 4 Dec 1973. 2p. Dep. NTIS $3.00.

14944 (DOCKET-50265-285) QUAD-CITIES STATION, UNIT 2. Unusual Event: An Isolation Valve on B RHR Heat Exchanger Was Found Partially Closed with Its Stem Uncoupled from Its Disc. (Commonwealth Edison Co., Cordova, Ill. (USA)). 4 Dec 1973. 2p. Dep. NTIS $3.00.

14945 (DOCKET-50267-94) FORT ST. VRAIN NUCLEAR GENERATING STATION. Progress Report on Ecological Inventory, Semiannual, November 1972-April 1973. (Public Service Co. of Colorado, Denver (USA)). 10 Dec 1973. 173p. Dep. NTIS $10.75.

Aquatic, avian, and terrestrial preoperation inventories and analyses are presented. Because of poor water quality, sandy bottoms and flow fluctuation, fish are highly resistant to environmental stress. Fish populations are controlled by natural environmental factors and upstream pollution. The yellow-headed and/or red-winged blackbird, house wren, and western meadowlark are recommended as indicator species for radiation monitoring. Vegetation characteristics are classified using hierarchical analysis. It appears that the power plant has little influence on background tritium concentrations and gross beta activity in cottonwood or kochia. Leaf injury could not be found. Two new species of small mammals were reported, the Norway rat and meadow mole. Voles, deer mice and house mice are the most common small mammal. Environmental changes in formicidae, trichoptera, heteroceridae, silpha ramosa, araneida, and collembola are reported. Dissolved metal concentrations decreased while particulate metal concentration in the water increased. The amount of metal associated with suspended solids was greater than the amount dissolved in the water. (FS)

14946 (DOCKET-50269-174) OCONEE NUCLEAR STATION, UNIT 1. Unusual Event Report UE-73-12: Malfunction of Engineered Safeguards Valve FDW-108. (Duke Power Co., Charlotte, N. C. (USA)). 7 Dec 1973. 2p. Dep. NTIS $3.00.

14947 (DOCKET-50269-178) OCONEE NUCLEAR STATION, UNIT 1. Failure of the Pressurizer Spray Valve. (Duke Power Co., Charlotte, N. C. (USA)). 19 Dec 1973. 2p. Dep. NTIS $3.00.

14948 (DOCKET-50269-180) OCONEE NUCLEAR STATION, UNIT 1. Power Distribution Comparison Status Report. (Duke Power Co., Charlotte, N.C. (USA)). 21 Dec 1973. 22p. Dep. NTIS $3.25.

14949 (DOCKET-50269-181) OCONEE NUCLEAR STATION, UNIT 1. Abnormal Occurrence Report No. AO-73-9: Momentary Inoperability of the Reactor Building Spray System. (Duke Power Co., Charlotte, N. C. (USA)). 20 Dec 1973. 4p. Dep. NTIS $3.00.

14950 (DOCKET-50270-141) OCONEE NUCLEAR STATION, UNIT 2. Incident Report: Corrosion Investigation of Tendons. (Duke Power Co., Charlotte, N. C. (USA)). 6 Dec 1973. 5p. Dep. NTIS $3.00.

14951 (DOCKET-50270-143) OCONEE NUCLEAR STATION, UNIT 2. Unusual Event Report No. UE-73-1: Malfunction of Engineered Safeguards Valve 2LP-22 and Low Pressure Injection Pump 2B. (Duke Power Co., Charlotte, N.C. (USA)). 11 Dec 1973. 3p. Dep. NTIS $3.00.

14952 (DOCKET-50271-264) VERMONT YANKEE NUCLEAR POWER STATION. Abnormal Occurrence Report No. AO-73-33: Malfunction of Pressure Switch PS-14-44B on the Core Spray System. (Vermont Yankee Nuclear Power Corp., Rutland (USA)). 5 Dec 1973. 1p. Dep. NTIS $3.00.

14953 (DOCKET-50271-269) VERMONT YANKEE NUCLEAR POWER STATION. Abnormal Occurrence Report No. AO-73-34: Problems Involving the A Station Service Water Pump 4 KV Breaker. (Vermont Yankee Nuclear Power Corp., Rutland (USA)). 27 Dec 1973. 2p. Dep. NTIS $3.00.

14954 (DOCKET-50271-271) VERMONT YANKEE NUCLEAR POWER STATION. Abnormal Occurrence Report No. AO-73-33: Malfunction of Pressure Switch PS 14-44B in the Core Spray System. (Vermont Yankee Nuclear Power Corp., Rutland (USA)). 12 Dec 1973. 2p. Dep. NTIS $3.00.

14955 (DOCKET-50271-273) VERMONT YANKEE NUCLEAR POWER STATION. Abnormal Occurrence Report No. AO-73-34: Bolt Loosening of 4 KV Breakers. (Vermont Yankee Nuclear Power Corp., Rutland (USA)). 19 Dec 1973. 2p. Dep. NTIS $3.00.

14956 (DOCKET-50271-274) VERMONT YANKEE NUCLEAR POWER STATION. Abnormal Occurrence Report No. AO-73-35: Malfunction of Valve V2-86C. (Vermont Yankee Nuclear Power Corp., Rutland (USA)). 20 Dec 1973. 1p. Dep. NTIS $3.00.

14957 (DOCKET-50271-275) VERMONT YANKEE NUCLEAR POWER STATION. Abnormal Occurrence Report No. AO-73-35: Malfunction of Valve V2-86C Causing the Reactor Protection Relay 5A-K3C to Deenergize. (Vermont Yankee Nuclear Power Corp., Rutland (USA)). 26 Dec 1973. 2p. Dep. NTIS $3.00.

14958 (DOCKET-50277-166) PEACH BOTTOM ATOMIC POWER STATION, UNIT 2. Abnormal Occurrence: HPCI Became Inoperable During a Startup Test. (Philadelphia Electric Co., Pa. (USA)). 13 Dec 1973. 1p. Dep. NTIS $3.00.

14959 (DOCKET-50277-167) PEACH BOTTOM ATOMIC POWER STATION, UNIT 2. Abnormal Occurrence: Malfunction of a Jet Pump Riser Differential Pressure Switch (dPIS-2-2-129A). (Philadelphia Electric Co., Pa. (USA)). 13 Dec 1973. 1p. Dep. NTIS $3.00.

14960 (DOCKET-50277-168) PEACH BOTTOM ATOMIC POWER STATION, UNIT 2. Abnormal Occurrence: HPCI Oil Piping Failure. (Philadelphia Electric Co., Pa. (USA)). 20 Dec 1973. 3p. Dep. NTIS $3.00.

14961 (DOCKET-50277-170) PEACH BOTTOM ATOMIC POWER STATION, UNIT 2. Abnormal Occurrence: Malfunction of Level Switch 231D on the Scram Discharge Volume. (Philadelphia Electric Co., Pa. (USA)). 11 Dec 1973. 3p. Dep. NTIS $3.00.

14962 (DOCKET-50280-199) SURRY POWER STATION, UNIT 1. Excessive Vibration of Reactor Coolant Pump 1A and Fluctuations in Primary Coolant Flow. (Virginia Electric and Power Co., Richmond (USA)). 3 Dec 1973. 2p. Dep. NTIS $3.00.

14963 (DOCKET-50280-200) SURRY POWER STATION, UNIT 1. Incident Report: Failure of Reactor Coolant Pump Shaft.

(Virginia Electric and Power Co., Richmond (USA)). 7 Dec 1973. 3p. Dep. NTIS $3.00.

14964 (DOCKET-50280-201) SURRY POWER STATION, UNIT 1. Abnormal Occurrence Report No. AO-S1-73-15: Failure of Boron Injection Tank Outlet Valve MOV-1867D to Open Upon Safety Injection. (Virginia Electric and Power Co., Richmond (USA)). 7 Dec 1973. 6p. Dep. NTIS $3.00.

14965 (DOCKET-50280-203) SURRY POWER STATION, UNIT 1. Unusual Event: Pump Shaft Failure on the "A" Reactor Coolant Pump. (Virginia Electric and Power Co., Richmond (USA)). 11 Dec 1973. 1p. Dep. NTIS $3.00.

14966 (DOCKET-50282-187) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Final Report on Deficient Motor Operated Valve Torque Switches. (Northern States Power Co., Minneapolis, Minn. (USA)). 16 Nov 1973. 2p. (DOCKET-50306-147). Dep. NTIS $3.00.

14967 (DOCKET-50282-189) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT 1. Abnormal Occurrence: Failure of Safeguards Logic Relay During Surveillance Testing. (Northern States Power Co., Minneapolis, Minn. (USA)). 4 Dec 1973. 2p. Dep. NTIS $3.00.

14968 (DOCKET-50282-194) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Final Report on Diesel Generator Scavenging Air Blower. (Northern States Power Co., Minneapolis, Minn. (USA)). 13 Nov 1973. 2p. (DOCKET-50306-149). Dep. NTIS $3.00.

14969 (DOCKET-50285-143) FORT CALHOUN STATION, UNIT 1. Unusual Event Report No. 73-8: Failure of Out of Core Wide Range ^{10}B Detectors. (Omaha Public Power District, Nebr. (USA)). 19 Nov 1973. 4p.

14970 (DOCKET-50285-144) FORT CALHOUN STATION, UNIT 1. Unusual Event Report No. 73-9: the INCA Code Parameters Determined that Errors Existed in the Uranium Masses Used to Determine Assembly Burnup. (Omaha Public Power District, Nebr. (USA)). 26 Nov 1973. 4p. Dep. NTIS $3.00.

14971 (DOCKET-50285-157) FORT CALHOUN STATION, UNIT 1. Abnormal Occurrence Report: Misadjustment of RPS Safety Settings. (Omaha Public Power District, Nebr. (USA)). 26 Dec 1973. 3p. Dep. NTIS $3.00.

14972 (DOCKET-50285-158) FORT CALHOUN STATION, UNIT 1. Unusual Event Report No. 73-11: The Spring Which Loads the Poppet Discharge Valve Was Broken in Several Pieces. (Omaha Public Power District, Nebr. (USA)). 10 Dec 1973. 5p. Dep. NTIS $3.00.

14973 (DOCKET-50289-150) THREE MILE ISLAND NUCLEAR STATION, UNIT 1. Incident Report: Inspection Showed that Vent Valve Thermocouple Nozzles on the Reactor Vessel Closure Head Were Distorted and the Corresponding Thermocouple Guide Tubes on the Plenum Assembly Were also Distorted. (Metropolitan Edison Co., Reading, Pa. (USA)). 20 Dec 1973. 3p. Dep. NTIS $3.00.

14974 (DOCKET-50289-151) THREE MILE ISLAND NUCLEAR STATION, UNIT 1. Incident Report: Partial Draining of the Reactor Coolant System. (Metropolitan Edison Co., Reading, Pa. (USA)). 4 Dec 1973. 3p. Dep. NTIS $3.00.

14975 (DOCKET-50293-204) PILGRIM NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence Report No. AO-73-27: IRM Channels E and F of the Reactor Protection System Were Found to Have High Flux Trip Settings. (Boston Edison Co., Mass. (USA)). 6 Sep 1973. 2p. Dep. NTIS $3.00.

14976 (DOCKET-50293-205) PILGRIM NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence Report AO-73-25: Radiation Monitor RM-1705-8D was Found Inoperable in its Ability to Trip Upon Detecting High Radiation. (Boston Edison Co., Mass (USA)). 21 Nov 1973. 1p. Dep. NTIS $3.00.

14977 (DOCKET-50293-206) PILGRIM NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence Report AO-73-36: Failure of the Lower Two Sets of Packing on a 28-Inch Valve Inside the Drywell. (Boston Edison Co., Mass. (USA)). 21 Nov 1973. 1p. Dep. NTIS $3.00.

14978 (DOCKET-50293-209) PILGRIM NUCLEAR POWER STATION, UNIT 1. Unusual Occurrence No. 73-17: Inoperability of HPCI Valve MO-2301-3. (Boston Edison Co., Mass. (USA)). 30 Nov 1973. 1p. Dep. NTIS $3.00.

14979 (DOCKET-50293-211) PILGRIM NUCLEAR POWER STATION, UNIT 1. Unusual Occurrence Report No. 73-18: Inoperability of an Inboard Main Steam Isolation Valve AO-203-1A. (Boston Edison Co., Mass. (USA)). 5 Dec 1973. 1p. Dep. NTIS $3.00.

14980 (DOCKET-50293-212) PILGRIM NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence Report No. AO-73-38: Malfunction of Fenwal Temperature Switches, Model 17023-6. (Boston Edison Co., Mass. (USA)). 12 Dec 1973. 1p. Dep. NTIS $3.00.

14981 (DOCKET-50293-214) PILGRIM NUCLEAR POWER STATION, UNIT 1. Unusual Occurrence Report No. UO-73-21: HPCI System Inverter Trip. (Boston Edison Co., Mass. (USA)). 22 Dec 1973. 1p. Dep. NTIS $3.00.

14982 (DOCKET-50295-222) ZION NUCLEAR PLANT, UNIT 1. Abnormal Occurrence: Malfunction of Containment Spray Additive Valve. (Commonwealth Edison Co., Zion, Ill. (USA)). 13 Dec 1973. 3p. Dep NTIS $3.00.

14983 (DOCKET-50302-106) CRYSTAL RIVER NUCLEAR PLANT, UNIT 3. Interim Report on Nonconformance During the Installation of the Nuclear Service Sea Water Piping. (Florida Power Corp., St. Petersburg (USA)). 9 Nov 1973. 3p. Dep. NTIS $3.00.

14984 (DOCKET-50324-126) BRUNSWICK STEAM ELECTRIC PLANT, UNITS 1 AND 2. Failure of Batteries to Meet Performance Specifications. (Carolina Power and Light Co., Raleigh, N. C. (USA)). 7 Nov 1973. 2p. (DOCKET-50325-125). Dep. NTIS $3.00.

14985 (DOCKET-50327-62) SEQUOYAH NUCLEAR PLANT, UNITS 1 AND 2. Environmental Radioactivity Levels, Semiannual Report, August 1972-January 1973. (Tennessee Valley Authority, Chattanooga (USA)). 4 Dec 1973. 39p. (DOCKET-50328-55). Dep. NTIS $4.00.

14986 (DOCKET-50327-66) SEQUOYAH NUCLEAR PLANT, UNITS 1 AND 2. Report No. 72-21, Stability Analyses of Containment Vessels. (Tennessee Valley Authority, Knoxville (USA)). 29 Nov 1973. 382p. (DOCKET-50328-59). Dep. NTIS $21.25.

Three analytical procedures available for evaluating stability of thin shells were used to analyze Sequoyah containment vessels. The most sophisticated and reliable method, the dynamic stability analysis, shows that the vessels provide a margin of safety between 5 and 10 for the overall stability. The static bifurcation analyses using a very severe loading condition show a minimum margin of safety of 4.6. And, the panel analyses between the stiffeners, which are insensitive to initial imperfections, show a margin of approximately 2.5. All analyses show that the vessels have an adequate margin of safety for the design load conditions. These factors show that under the most conservative of assumptions of load variation and analytical techniques, in conjunction with classical stability guides, the containment vessels will not approach a buckled condition much less a collapse load. Based on the results of these analyses, the containment vessels conservatively have more than adequate stability to pass through the short durations, nonaxisymmetric pressure loading condition and remain a safe, undeformed barrier. (auth)

14987 (DOCKET-50331-128) DUANE ARNOLD ENERGY CENTER. Information re the Apparent Misalignment of the Reactor Building Crane Pinion Gear. (Iowa Electric Light and Power Co., Cedar Rapids (USA)). 16 Nov 1973. 3p. Dep. NTIS $3.00.

14988 (DOCKET-50331-129) DUANE ARNOLD ENERGY CENTER. Unusual Event: Reactor Building Crane Overload. (Iowa Electric Light and Power Co., Cedar Rapids (USA)). 19 Nov 1973. 3p. Dep. NTIS $3.00.

14989 (DOCKET-50338-101) NORTH ANNA POWER STATION, UNITS 1 AND 2. Report on Steam Generator and Reactor Coolant Pump Support Repairs. (Virginia Electric and Power Co., Richmond (USA)). 9 Nov 1973. 27p. (DOCKET-50339-98). Dep. NTIS $3.50.

14990 (DOCKET-50341-76) ENRICO FERMI ATOMIC POWER PLANT, UNIT 2. Common Mode Failure of Safety/Relief Valves. (Detroit Edison Co., Mich. (USA)). 15 Nov 1973. 9p. Dep. NTIS $3.00.

14991 (DOCKET-50341-77) ENRICO FERMI ATOMIC POWER PLANT, UNIT 2. Post-LOCA Hydrogen Control System. (Detroit Edison Co., Mich. (USA)). 28 Nov 1973. 21p. Dep. NTIS $3.25.

14992 (DOCKET-50348-87) JOSEPH M. FARLEY NUCLEAR PLANT, UNIT 1. Summary Report re a Fire Involving the Reac-

tor Upper Internals. (Alabama Power Co., Birmingham (USA)). 26 Nov 1973. 4p. Dep. NTIS $3.00.

14993 (DOCKET-50409-80) LA CROSSE BOILING WATER REACTOR. Monthly Operating Report, September 1973. (Dairyland Power Cooperative, La Crosse, Wis. (USA)). 1973. 23p. Dep. NTIS $3.25.

The reactor was critical for 660.8 hours with the turbine-generator connected to the DPC grid for 630.4 hours. Operational problems occurred with the seal injection system for the forced circulation pumps, and the turbine steam reheater developed a flange leak. One normal reactor shutdown was scheduled and conducted during the month for repairing the seal injection system and to investigate and correct the reheater flange steam leak. Off-gas released during the month averaged 5,880 μCi/second during reactor operation, with a maximum hourly rate of 11,441 μCi/second. (auth)

14994 (DOCKET-50409-88) LACROSSE BOILING WATER REACTOR. Monthly Operation Report, October 1973. (Dairyland Power Cooperative, La Crosse, Wis. (USA)). 1973. 20p. (LAC-TR-2). Dep. NTIS $3.00.

14995 (DOCKET-50409-89) LACROSSE BOILING WATER REACTOR. Power-flow Anomaly Test and Analysis. (Dairyland Power Cooperative, La Crosse, Wis. (USA)). 19 Dec 1973. 42p. Dep. NTIS $4.25.

14996 (DOCKET-50412-45) BEAVER VALLEY POWER STATION, UNIT 2. USAEC Safety Evaluation Report. (Duquesne Light Co., Pittsburgh, Pa. (USA)). 9 Nov 1973. 240p. Dep. NTIS $14.00.

Results of the technical evaluation of the Beaver Valley Unit 2 facility are summarized and the scope of the technical matters considered in evaluating the radiological safety aspects of the facility are delineated. Based on this evaluation, Beaver Valley-2 can be constructed and operated, as proposed, without endangering the health and safety of the public. The facility will be located on the south bank of the Ohio River about 25 miles from Pittsburgh, Pennsylvania. Proposed initial power will be 2652 MW(t). (FS)

14997 (DOCKET-STN-50470-2) PWR NUCLEAR STEAM SUPPLY SYSTEM 80. PSAR, Volume 2. (Combustion Engineering, Inc., Windsor, Conn. (USA)). 18 Dec 1973. 507p. Dep. NTIS $27.50.

The engineered safety features provided to mitigate the consequences of postulated accidents are described. Included are the containment systems, ECCS, and the habitability system. An appendix concerning the method used for the calculation of the removal of iodine by the containment spray system is presented. (FS)

14998 (DOCKET-STN-50470-3) PWR NUCLEAR STEAM SUPPLY SYSTEM 80. PSAR, Volume 3. (Combustion Engineering, Inc., Windsor, Conn. (USA)). 18 Dec 1973. 849p. Dep. NTIS $44.50.

The instrumentation and control systems which monitor and perform safety related functions are described including the reactor protective system, engineered safety features systems, systems required for safe shutdown, safety related display instrumentation, other systems required for safety, and control systems not required for safety. An appendix concerning core protection calculated trips is presented. Information concerning offsite, onsite, ac and dc power is described. Information is presented on fuel storage and handling, water systems, process auxiliaries, heating, ventilation, cooling, and air conditioning. The steam and power conversion system including the turbine generator, main steam supply system, main condenser, circulating water system, condensate cleanup, feedwater and condensate system, and the steam generator blowdown is presented. Management of liquid, gaseous, and solid wastes is discussed and programs for radiological monitoring of process, effluent, and offsite radiological monitoring are explained. (FS)

14999 (DOCKET-STN-50470-4) PWR NUCLEAR STEAM SUPPLY SYSTEM 80. PSAR, Volume 4. (Combustion Engineering, Inc., Windsor, Conn. (USA)). 18 Dec 1973. 587p. Dep. NTIS $31.50.

Information is presented concerning shielding, ventilation, the health physics program, test program, evaluation of operational transients, technical specifications for the protection system, instrumentation surveillance, safety limits and limiting safety systems settings, operational monitoring and administrative controls. The quality assurance program for design, procurement, construction, and operation is discussed. (FS)

15000 (DOCKET-50471-12) PILGRIM NUCLEAR POWER STATION, UNITS 2 AND 3. Environmental Report, Volume 1. (Boston Edison Co., Mass. (USA)). 20 Dec 1973. 420p. (DOCKET-50472-11). Dep. NTIS $23.00.

The environmental effects of construction and operation of the Pilgrim Nuclear Power Station, Units 2 and 3 are examined. The descriptions include: the environment in the area, including the history, geography, geology, hydrology, climatology, ecology, land and water use including chemical characteristics; the facility and its effluents; the impacts from construction and operation of the facility; alternatives to the proposed action; irreversible and irretrievable long-term commitments of resources from plant operation; need for power; and the benefits-cost analysis of the proposed plant operation. (FS)

15001 (DOCKET-50471-13) PILGRIM NUCLEAR POWER STATION, UNITS 2 AND 3. Environmental Report, Volume 2. (Boston Edison Co., Mass. (USA)). 1973. 381p. (DOCKET-50472-12). Dep. NTIS $21.25.

15002 (DOCKET-50471-14) PILGRIM NUCLEAR POWER STATION, UNITS 2 AND 3. Environmental Report, Volume 3. (Boston Edison Co., Mass. (USA)). 1973. 475p. (DOCKET-50472-13). Dep. NTIS $25.75.

15003 (WASH-1283) GUIDANCE ON QUALITY ASSURANCE REQUIREMENTS DURING DESIGN AND PROCUREMENT PHASE OF NUCLEAR POWER PLANTS. (USAEC, Washington, D. C.). Jun 1973. 110p. Dep. NTIS $7.50.

Standards drafted by the American National Standards Institute (ANSI) for nuclear quality assurance programs for the design and procurement phase of nuclear power plants are presented. USAEC Regulatory Staff comments and supplementary guidance on these standards are included. (JWR)

15004 ANTITRUST ASPECTS OF NUCLEAR PLANT PROCEDURES. Bane, C. A. (Isham, Lincoln and Beale, Chicago). Pub. Util. Fortn.; 92: No. 7, 46-53(27 Sep 1973).

An analysis is presented of a very difficult but promising effort to work out a cooperative arrangement for group purchases of standardized nuclear power plant facilities within compliance with antitrust laws and procedures. (auth)

15005 STAFFING NUCLEAR PLANTS. Deutsch, R. W. Power Eng.; 77: No. 9, 60-62(Sep 1973).

Strong programs are needed promptly to bring new personnel into the nuclear power field and to prepare them for operation and support functions four or five years hence. Specific steps for implementing such programs are recommended. It is stressed that if the utilities at large do not take such steps now to meet the relatively short-range manpower needs, many plants at the construction permit stage today may not have the plant staff to satisfy AEC requirements for an operating license, and that if only some utilities take corrective steps now, others might continue to bid competitively for the relative small supply of already trained personnel. (LCL)

15006 TRAINING NUCLEAR OPERATORS. Kelly, F. L. Power; 117: No. 7, 58-59(Jul 1973).

The training of nuclear power plant operators to meet USAEC operator licensing requirements and programs which must be formulated to meet the needs for initial operator training, replacement operator training, and retraining are discussed. (LCL)

15007 NEW ORIENTATIONS OF THE ITALIAN NUCLEAR LEGISLATION IN POINT OF AUTHORIZATIONS. Nocera, F. (Comitato Nazionale per l'Energia Nucleare, Rome); Carbone, F. (1973). vp.

From first international meeting on nuclear law: Nuclear Inter Jura 73; Karlsruhe, Ger. (11 Sep 1973).

The communication illustrates the contents of the draft being dealt with at present by the Senate, introducing modifications to "latu sensu" authorizing system of radioactive material. Such modifications, besides concerning the juridical system for the possession of such material (especially special fissile material), are of interest to the authorizing regime regarding transportation. This bill purports to innovate by solely requesting the observance of the constituent technical regulations forming the object of the regulations to be issued already specifically envisaged by the Atomic Energy Law of 1962. Several modifications are also envisaged with regard to the public liability connected with the transport. A modification proposal should be mentioned, as well as the object of a bill, concerning the location of the plants for the production of electric power. The bill, though not envisaging innovations in the nuclear provisions, is interested on a long-term basis in both thermal and thermal-nuclear plants, having inevitable after effects on the general regulations of power plants. (GE)

15008 LICENSING OF NUCLEAR POWER REACTORS IN THE UNITED STATES: NEW DEVELOPMENTS. Sharper, H. K. (Atomic Energy Commission, Washington, DC). (1973). vp.

From first international meeting on nuclear law: Nuclear Inter Jura 73; Karlsruhe, Ger. (11 Sep 1973).

Outline of significant new developments: 1) the USAEC's policy of encouraging "standardization" of nuclear power plants and the regulatory approach to the licensing of barge-mounted reactors that will be operated in an ocean environment; 2) the conduct of rule making hearings in connection with the issuance of AEC regulations; 3) some current ideas that have surfaced in connection with the possible extension and revision of nuclear hazard indemnification legislation in the US; and 4) a legislative proposal that would separate the developmental functions of the AEC from its licensing and related regulatory functions. (GE)

15009 CONTRIBUTIONS TO NUCLEAR LEGISLATION IN SPAIN. Tocino, I. (Univ., Madrid). (1973). vp. (In Spanish).

From first international meeting on nuclear law: Nuclear Inter Jura 73; Karlsruhe, Ger. (11 Sep 1973).

A survey is given on what has happened in Spain during the last year as regards nuclear legislation: the Nuclear and Radioactive Installations Act of July 21, 1972, which regulates the planning, installation, construction, and exploitation of nuclear and radioactive installations as well as the fabrication of equipment for the handling of nuclear or radioactive materials; Spain adhered by means of an official decree of July 9, 1972, to the European Agreement for International Transport of Dangerous Goods by Road; Spain is lacking specific legislation for nuclear installations from the administrative point of view. This lack is covered by means of standards and technical specifications for which examples are given; case studies dealing with nuclear legislation are presented; description of courses on nuclear legislation at Spanish universities. (GE)

15010 NUCLEAR ENERGY IN THE TECHNICAL WORLD OF TOMORROW. Haefele, W. (Kernforschungszentrum, Karlsruhe, Ger.). (1973). vp. (In German).

From first international conference on nuclear law: Nuclear Inter Jura; Karlsruhe, Germany (11 Sep 1973).

The technical developments in the field of nuclear energy up to the present state are surveyed. The main objections against nuclear energy are listed together with critical comments. Finally, the role of nuclear energy in the future energy supply is discussed. (GE)

15011 REACTOR LICENSING AND SAFETY REQUIREMENTS. Hurst, D. G.; Boyd, F. C. (Atomic Energy Control Board, Ottawa). pp vp of Proceedings of the 1972 Annual Conference of the Canadian Nuclear Association. Chalk River, Ont.; Atomic Energy of Canada Ltd. (1972).

From Canadian Nuclear Association 1972 annual conference; Ottawa, Ontario (11 Jun 1972). Paper No. 72-CNA-102.

The Atomic Energy Control Board, in its reactor licensing, proceeds through the stages of Site Approval, Construction Licence, and Operating Licence. The basic information requirements are outlined. With increasing experience there have been some evolutionary changes in design and operating requirements, although the radiation dosage criteria remain essentially the same. As an alternative to the conceptual division for safety evaluation into process systems, protective systems, and containment, a nuclear plant may now be regarded as composed of two groupings of process systems and safety systems. The target reliabilities for safety systems have been made somewhat more stringent. Some possible trends in safety criteria and licensing requirements are outlined. Although considerable attention is given to effluents and to radiation exposures from normal operation, the licensing process will continue to concentrate on ensuring that the chance of a major release of radioactive fission products is negligibly small. (auth)

15012 LICENSING CONDITIONS FOR COOLING PROCEDURES OF NUCLEAR POWER PLANTS. Pfister, W. (Eidgenoessisches Amt fuer Energiewirtschaft, Bern). (1973). vp. (In German).

From first international meeting on nuclear law: Nuclear Inter Jura 73; Karlsruhe, Ger. (11 Sep 1973).

Some problems are reported that result from the thermal load of waters by nuclear power plants in the domestic and international range. The expertise of the influences of cooling towers on the environment in Switzerland is briefly discussed. (GE)

15013 NUCLEAR FUEL FABRICATION AND QUALITY ASSURANCE. Smiley, S. H. Nucl. Mater. Manage.; 11: No. 3, 463-472(Fal 1973).

From proceedings of the 14th annual meeting of the Institute of Nuclear Materials Management, Inc.; San Diego, CA (20 Jun 1973).

The AEC's quality assurance requirements are described for nuclear fuel design and fabrication, and for nuclear power plant design, construction, and operation. (DCC)

GENERAL

Energy Utilization and Economics

Refer also to abstract 14750.

15014 (BNL-18376) SURVEY OF LARGE-SCALE APPLICATIONS OF SUPERCONDUCTIVITY. Informal Report. Powell, J. R. (Brookhaven National Lab., Upton, N.Y. (USA)). 1973. 167p. (CONF-730970-). Dep. NTIS $10.50.

From Advanced Study Institute on Large Scale Applications of Superconductivity and Magnetism; Entreves, Italy (5 Sep 1973).

A survey is made of potential future large-scale uses of superconductivity, including fusion, MHD, magnetic energy storage, power transmission, high-speed ground transport, and magnetic separation. The superconducting technological requirements for each application are examined with regard to present and projected capabilities. The requirements of the nonsuperconducting system components in each application are also examined, together with an investigation of how advances in superconducting technology can ease demands on the nonsuperconducting components. Economic and social factors relating to each application are also discussed. An assessment of the likelihood of success for each application is made. (18 tables, 27 figures, 89 references) (auth)

15015 (CONF-730223-1) ENERGY RESOURCES AND USAGE. Charles Kolling Research Lab. Technical Note ER-2. George, D. W. (Sydney Univ. (Australia). Dept. of Mechanical Engineering). Feb 1973. 23p. Dep. NTIS (U.S. Sales Only) $3.25.

From maximum utilization of industrial energy conference; Sydney, Australia (21 Feb 1973).

The overall picture shows that Australia faces no foreseeable energy problems. Such an assumption ignores many technological and environmental problems associated with the inefficient or thoughtless use of invaluable energy resources. Energy wasted is irrecoverable whereas energy un-used has a potentially individual and national good either in subsequent usage or in export to some less-favorably placed country. No rushed or ill-considered decision need be made, and with the advent of nuclear power or an export decision to be made, the decisions may be well planned. Issues such as Lake Pedder, the Clutha controversy, and the forthcoming public inquiry into environmental aspects of the proposed Moomba–Sydney natural gas pipeline give an indication of the pattern of the future, and an informed public interest in such matters should be welcomed by all concerned. National planning and coordination are correlated with technological advances for the optimum decisions to be made involving energy. (24 references) (MCW)

15016 (CONF-730848-1) ELECTRIC CAR. Nelson, P. A. (Argonne National Lab., Ill. (USA)). 1973. 10p. Dep. NTIS $3.00.

From international symposium and workshop in the hydrogen economy; Ithaca, New York, USA (19 Aug 1973).

If a suitable battery can be developed, the electric automobile would definitely have a place in the transportation field. It is believed that a suitable battery can be developed because of the recent successes at ANL and elsewhere and because better cell systems may result from basic electrochemical studies. The manufacture of electric cars to the extent of 1 to 2% of the total automobile production in 1985 is a reasonable prospect. (auth)

15017 (EP-RR-32, pp 210-220) FUTURE OF MHD ELECTRIC POWER GENERATION IN AUSTRALIA. Messerle, H. K. (Univ. of Sydney). Oct 1972.

From plasma physics seminar-1972 meeting; Canberra, Australia (9 Mar 1972).

There has been a world wide resurgence of interest in MHD electric power generation. Major national programs have evolved in the USSR, West Germany, and Japan and an extensive new program has commenced in the USA. In the USSR, a 25-MW power station was run up in 1971 and a 1500-MW station is in the design stage. The next decade should see the construction of the first fossil-fuel-fired peak-load and emergency power station. If successful, large-scale base-load stations will follow, offering much higher efficiency than modern stations and most effective reduction in thermal and atmospheric pollution. Developments in MHD should have a direct bearing on Australian energy policy, considering dependence on coal-fired stations, well into the 21st century. This lecture summarizes the scientific and technical problems still to be faced in this field. (auth)

15018 (INIS-mf-941) COST–BENEFIT ANALYSIS FOR THE IMPLANTATION OF THE NUCLEAR INDUSTRY IN BRAZIL. Scarpinella, C. A. (Sao Paulo Univ. (Brazil). Escola Politecnica). 1972. 80p. (In Portuguese). INIS.

Thesis.

A model using a set of evaluation functions for the alternatives is proposed as follows: aggregate consumption benefit; benefit from redistribution of consumption per region; service cost benefit; capital costs; fitness to the national resources plan; effectiveness in scale integration; effectiveness in sequence integration. The evaluation functions assign numbers as scores to the alternatives that allow a total evaluation to be built by simple sum or by ponderation. The proposed model allows an evaluation that includes all types of criteria, instead of just part of them, with the possibility to be reused for a broad variety of situations in the development stage of the project. (tr-auth)

15019 (JPRS-60673, pp 1-7) EXPERIMENTAL GEOTHERMAL POWER STATION. 3 Dec 1973. Translated from K'o Hsueh Shih Yen; No. 6, 36-37(1971). NTIS.

In translations on People's Republic of China, No. 250.

A geothermal power station was built at Feng-shun Hsien of Kwangtung Province. The geothermal shaft is 800.81 meters in depth, and the water temperature at the well bottom is 103.5°C and at the opening 91°C. The water head's absolute pressure is 1.65 kg/mm^2 and the geothermal artesian flow rate is 80 tons/hour. The thermal power system of this experimental power station is primarily composed of the degasser, volume expander, steam turbine, condenser, gas pump, and four water pumps. Hot water is introduced from the geothermal well opening to a relatively low-pressure container (expansion container), where part of the hot water is vaporized to produce steam to push the steam turbine and the generator to generate electricity. The rubber axle seal (tight seal at the bearings) and the water ejection pump were used to solve the problems concerning the steam turbine's axle seal and pump. The air pressure is reduced, the system's equipment is simplified, and fuel is no longer necessary. The thermal power system of the experimental station is shown. (auth)

15020 (JPRS-60673, pp 8-15) WAYS SOUGHT TO TAP EARTH'S INTERNAL HEAT. 3 Dec 1973. Translated From K'o Hsueh Shih Yen; No. 6, 33-35(1971). NTIS.

In translations on People's Republic of China, No. 250.

The hot springs at Peking's Hsiao-tang-shan, Liaoning's Tanggang-tsu, and Shansi's Hua-ch'ing-ch'ih are famous hot springs of China. In recent years, reports on hot springs from various places have been numerous, and the number of the hot water wells has greatly increased due to tremendous progress accomplished in geology. An extremely rich resource in Earth's heat is kept within the national boundary. Ways to exploit these resources are discussed briefly. (MCW)

15021 (JUL-954-TP) POWER TRANSMISSION WITH LOW-TEMPERATURE NORMAL-CONDUCTING CABLES. Optimization Problem and Cost Structure. Heller, I.; Hofmann, A. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Inst. fuer Technische Physik). May 1973. 73p. (In German). Dep. NTIS (U.S. Sales Only) $5.75.

An economic comparison was made between the investigated types of a cryocable and an advanced normal-temperature-cable, i.e., an artificially cooled SF_6 cable. As this is done on a uniform basis, the result will surely have a high reliability. The comparison shows that the LN_2–vacuum–tube cable is not competitive with the advanced SF_6–tube cable within the whole region of power investigated. The LN_2–litz–conductor cable on the other hand is able to compete when power and length are high. This is especially true if it can be shown that the estimation of the fabrication costs of the conductor were too pessimistic. Experimental research on losses and fabrication problems of litz conductors with high cross sections are very important and will be decisive for cryocable development. (27 figures, 35 references) (auth)

15022 (LA-5456-MS) NUCLEAR HEAT AND HYDROGEN IN FUTURE ENERGY UTILIZATION. Booth, L. A.; Balcomb, J. D. (Los Alamos Scientific Lab., N. Mex. (USA)). Nov 1973. Contract W-7405-eng-36. 28p. Dep. NTIS $4.00.

Future demand for the world's supply of carbon-based fuels will eventually deplete this supply to the point at which their use becomes economically infeasible. Hydrogen, which is virtually inexhaustible in the form of water, could be substituted for natural gas and petroleum-based fuels for industrial and residential heating and for transportation. Nuclear energy, either fusion or fission, would be the primary energy source. Thermal energy from the nuclear heat source would be converted to electric energy in a conventional heat-engine cycle. Hydrogen could be produced from water by a cyclic thermochemical process.

Gaseous hydrogen for industrial and residential heat would be transported in a high-pressure pipeline system. Liquid hydrogen or hydrogen stored in metal hydrides could be used for transportation fuels. Energy complexes of two types would form the basis of this future energy economy: large plants, located offshore would produce hydrogen and electricity with desalted water as a byproduct; and smaller plants, located inland near urban centers, would produce primarily electricity and hydrogen. (46 references) (auth)

15023 (LBL-2232) ELECTROCHEMICAL ASPECTS OF THE HYDROGEN ECONOMY. Muller, R. H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1973. Contract W-7405-eng-48. 9p. (CONF-730848-2). Dep. NTIS $3.00.

From international symposium and workshop on the hydrogen economy; Ithaca, New York, USA (19 Aug 1973).

Electrolytic hydrogen is too expensive for use as a general-utility fuel for the near-term. This conclusion is valid as long as carbonaceous materials, in the form of liquid or gaseous hydrocarbons, and in the form of coal in the future, are available for producing hydrogen or synthetic hydrocarbons. For the long-range future, water electrolysis is at present the only feasible, although imperfect, route to make hydrogen without the use of carbonaceous materials and discharge of carbon monoxide. For the medium-range future, a likely initial use of electrolytic hydrogen generation lies in the off-peak electrical energy storage. The chemical energy contained in the hydrogen may then be used as a source of heat or re-converted in the hydrogen to electrical energy. It appears that for a largely nuclear electrical power system there will be great need for off-peak energy storage. Improvements in water electrolysis for the production of hydrogen are necessary. (MCW)

15024 (ORNL-EIS-73-52(Vol.1)(No. 11)) NSF-RANN ENERGY ABSTRACTS. A Monthly Abstract Journal of Energy Research. Guthrie, M. P. (ed.). (Oak Ridge National Lab., Tenn. (USA)). Nov 1973. Contract W-7405-eng-26. 25p. Dep. NTIS $3.25.

The bibliography contains 91 abstracts on energy sources, electric power (generation, supply and demand, transmission, environmental effects, and use), and energy (production, consumption, supply and demand, and policy). The research publications cited are technical journal articles, popular or semi-technical magazine articles, topical reports, progress reports, symposium papers and proceedings, monographs, and books published within the past two years. (MCW)

15025 (ORNL-TM-4433) CRYOGENIC POWER TRANSMISSION TECHNOLOGY: CRYOGENIC DIELECTRICS. Quarterly Report, July 1—September 30, 1973. (Oak Ridge National Lab., Tenn. (USA)). Jan 1974. Contract W-7405-eng-26. 16p. Dep. NTIS $3.00.

An investigation of the dielectric properties of fluids and solids for use in superconducting systems is underway at the Oak Ridge National Laboratory as part of the AEC program in superconducting power transmission. The investigation initially will encompass ac and dc breakdown and pre-breakdown phenomena in liquid helium and in a variety of solids in liquid helium. Extension to impulse measurements is expected in the near future. A prime objective of the investigation is to determine scaling laws applicable to various models of superconducting cables and other cryogenic apparatus. The experiments are being devised with this objective in mind. Experimental facilities have been set up for ac testing with a series resonant transformer to 700 kV rms and for dc testing to 600 kV. A high-voltage cryostat has been designed for service to 1000 kV with provision for optical as well as electrical recording of both breakdown and pre-breakdown phenomena. Other apparatus for testing to lower voltages is also available. Instrumentation for partial discharge measurements by multichannel pulse height analysis, high speed oscilloscope, and bridge detection are available. The influence of electrode surfaces and impurities as well as pressure and temperature on the dielectric properties of liquid helium will be determined. The behavior at large gaps is of particular interest. Breakdown and surface flashover of bulk and laminated solids in liquid helium and in vacuum at liquid helium temperatures are to be included in the investigations. (auth)

15026 (ORNL-tr-2780) THERMAL DECOMPOSITION OF WATER IN CHEMICAL CYCLES OF THE $Fe-Cl_2$ FAMILY. Hardy-Grena, C. (Commission of the European Communities, Ispra (Italy). Joint Nuclear Research Center). [nd]. Translation by M. Gerrard of EUR-4958. 10p. Dep. NTIS $3.00.

Thermal decomposition of water by chemical cycles is considered from the theoretical standpoint. From the thermodynamic conditions imposed (temperature limits of the operation cycle, free-energy-value limits for the different reactions that make up the cycle, etc.), only chlorine of the elements in Mendeleev's table can be considered as a reagent in the decomposition of water by an element. Based on this conclusion, a group of cycles was developed that use compounds of iron and chlorine. This $Fe-Cl_2$ family has the advantage of being based on common elements and having few problems of corrosion and pollution. (auth)

15027 (SLA-73-1025) TRANSCRIPT OF TALK ON SOLAR ENERGY. Stromberg, R. P. (Sandia Labs., Albuquerque, N. Mex. (USA)). Dec 1973. Contract AT(29-1)-789. 16p. Dep. NTIS $3.00.

The report presents a transcript of a solar energy talk that emphasizes the potential for a solar community as developed by Sandia Laboratories, Albuquerque, New Mexico. (auth)

15028 WORLD ENERGY CRISIS HAS ALREADY BEGUN. Schieweck, E. (1973). vp. (In German).

The energy supply problems of the present and next decades in the USA are explained. Energy sources of petroleum, natural gas, coal, nuclear energy, and water power are studied. Environmental, financial, and currency problems are discussed. The energy consequences for the FRG are described. (GE)

15029 BEOWAWE STILL ROARS: REPROACH AND REHASH. Wehlage, E. F. Geotherm. Energy Mag.; 1: No. 2, 14-18(Sep 1973).

Beowawe Hot Springs is located 250 miles northeast of Reno, Nevada. Exploratory drilling occurred in the period 1959 to 1965 by Magma Power Co. and Associates and Vulcan Thermal Power Company. Mystery now veils the ownership of the Beowawe Little Geysers, but visits in 1972 and 1973 reveal their adaptability for a fine geothermal laboratory. (MCW)

15030 ENERGY IN THE USA AFTER THE PRESIDENT'S MESSAGES: CHANGES IN INVESTMENT AND BALANCE OF PAYMENTS. Simon, W. E. (Dept. of the Treasury, Washington, DC). Energy Policy; 1: No. 3, 187-194(Dec 1973).

The energy problems of the USA up to 1980 are examined from the vantage point of the Treasury Department and the Oil Policy Committee. How present difficulties arose and what will be the impact of the President's new proposals on further exploration and development for oil production, on refinery construction, and on balance of payments are discussed. The effect of the action may change the way of life in the developed world, and it could be for the better if this is used as an opportunity to eliminate waste and strive for efficiency in energy use. (MCW)

15031 GEOTHERMAL ENERGY: POTENTIAL OF WASHINGTON STATE. Russell, R. H. Geotherm. Energy Mag.; 1: No. 4, 39-48(Dec 1973).

The State of Washington generally, the southern Cascades principally, and the Northern Cascades and Olympic Mountains, to a lesser degree, do possess geohydrologic parameters, thermal springs, and other surface and subsurface manifestations that suggest that the state may have the potential for a moderate to major geothermal energy resource. Geologic, hydrologic, and geophysical investigations and evaluations will be required, however, before reservoirs can be identified and defined and their energy potential estimated on a quantitative and qualitative basis. If environmental-impact problems can be resolved within acceptable limits, then an objective and viable investigation, evaluation, and test drilling program should be started. One area, North Bonneville, stands out as a preferred site for initial geothermal energy potential testing. (auth)

15032 METHANOL: A VERSATILE FUEL FOR IMMEDIATE USE. Reed, T. B.; Lerner, R. M. (Massachusetts Inst. of Tech., Cambridge). Science; 182: No. 4119, 1299-1304(28 Dec 1973).

The advantages of using methanol as a fuel and the ways in which it can be utilized immediately into the fuel economy are discussed. Methanol can be made from natural gas, petroleum, coal, oil shale, wood, farm and municipal wastes; easily stored in conventional fuel tanks and shipped in tank cars, tank trucks, and tankers; can be transported in oil and chemical pipelines. Up to 15% of methanol can be added to commercial gasoline in cars now in use without modification to the engines. The methanol–gasoline mixture results in improved economy, lower exhaust temperature, lower emissions, and improved performance compared to the use of gasoline alone. Methanol can be used for most other fuel needs, and is especially suited for use in fuel cells for generating electricity. (35 references). (MCW)

15033 SUPERCONDUCTIVE ENERGY STORAGE INDUCTORS FOR POWER SYSTEMS. Mohan, N. Madison, WI; Univ. of Wisconsin (1973). 111p. University Microfilms Order No. 73-20,266.

Thesis (Ph. D.).

Large toroidal magnets with superconductive windings could serve to perform a system function equivalent to hydro pumped storage. In sizes greater than 1,000 MW-hrs, preliminary economic studies have shown some promise. It is demonstrated by means of computer simulation that the power flow through the energy-storage inductor can be reversed within a few cycles using a conventional Graetz converter bridge with an appropriate control. A system with interconnected steam–electric areas is simulated on the hybrid computer. The system performance, with and without the energy-storage device, is studied in response to the random load changes. The deviation of area frequency from the normal and the change in tie-line power flow are used as error signals for controlling the energy-storage inductors. Results show that a large superconductive inductor and a Graetz bridge with appropriate control can function as a reversible-power energy-storage device. The energy-storage inductors can provide significant system electromechanical damping if the Graetz bridge is properly controlled. Computer studies reveal that this damping capability, even without superconductivity, is useful in presently available smaller inductor sizes when energy storage in large amounts is not the primary objective. Storage batteries can also be used for energy-storage purposes in power systems and provide a system damping equivalent to energy-storage inductors. (Diss. Abstr. Int., B)

15034 BLADELESS TURBINES: A GEOTHERMAL PRIME-MOVER AND RE-INJECTION PUMP. Possell, C. R. (Federal Engineering and Manufacturing, Inc., San Diego, CA). Geotherm. Energy Mag.; 1: No. 1, 20-21(Aug 1973).

The success of economically converting geothermal energy depends upon the solution to the problem of handling a two-phase effluent of steam and hot brine for recovery of energy. The effluents contain high percentages of superheated water and dissolved solids. More costly closed or binary cycle systems that utilize some form of heat exchange system with attendant penalties in system efficiency and deposition problems are necessary. The new bladeless turbine developed by U. S. Federal Engineering and Manufacturing, Inc., of San Diego discards conventional impulse and reaction design principles in favor of "boundary layer drag" to accomplish the energy conversion from steam, or hot brine, to rotating shaft power without any "impingement". The hot steam and liquid are brought into the turbine case by suitable peripheral nozzles at a tangent to a number of flat discs that are fixed on a rotating shaft. The hot effluent with a high kinetic energy is directed inwardly with a helical path until discharged through holes in the discs located near the shaft. (MOW)

15035 HAWAII VOLCANO ENERGY. Sheets, G. M. Geotherm. Energy Mag.; 1: No. 1, 23-24(Aug 1973).

The exploration and development of volcano energy in Hawaii was proposed by the center for Engineering Research at the University of Hawaii. Funds have been pledged by private sources, federal agencies, State of Hawaii, and Hawaii County to accomplish minimal necessary investigation of geological, engineer, socio-economic, and environmental base-line data concerning the potential for access to geothermal energy. The geology of the islands is briefly discussed. (MCW)

15036 MEXICO TURNS TO STEAM ENERGY: CERRO PRIETO. Manley, C. C. Geotherm. Energy Mag.; 1: No. 1, 22(Aug 1973).

The 75,000 kW generating plant at Cerro Prieto, Mexico is beginning operation using superheated steam from depths of 4,000 feet surrounding the extinct volcano. The experiment began in 1956. Steam used to turn the Japanese-made turbogenerators can be condensed into salt-free potable water, and ultimately used for irrigation. The Mexicali Valley south of Cerro Prieto is an extension of Imperial Valley. (MCW)

15037 GEOTHERMAL EXPLORATION ON PUBLIC LANDS: WHEN AND UNDER WHAT CONDITIONS. Bowen, R. G. Geotherm. Energy Mag.; 1: No. 1, 25-26(Aug 1973).

A bill authorizing the exploration and development of geothermal resources on public lands was signed in the early 1970's. No permits or leases have been granted, and the author feels there may have been a deliberate effort to keep geothermal development from competing with more-favored energy sources. White's estimation (30,000 MW) on which the administration based its assumptions, is not thought to be more valid than that of Rev(Hickel report) who estimated 395,000 megawatts from geothermal energy. It appears that geothermal regulations are at a standstill. (MCW)

15038 GEOTHERMAL TEST GENERATOR UNIT: THIRD ELECTRIC GENERATOR IN NORTH AMERICA. Wehlage, E. F. Geotherm. Energy Mag.; 1: No. 1, 27-28(Aug 1973).

The helical rotary screw expander was developed as a geothermal fluid prime mover for driving a generator adapted for reverse operation from a relatively new type of air and gas compressor developed in Sweden as the Lysholm rotary-screw compressor. Test runs were made at Cerro Prieto and indicate a great potential for practical applications on a larger scale for geothermal power generation. The expander system produces power from hot, mineral-depositing brines. The system upgrades the current power recovery, reduces current plant costs, simplifies current installations, and allows fresh water extraction. (MCW)

15039 GEOTHERMAL: THE PROBLEM OF DEFINITION. Summers, W. K. Geotherm. Energy Mag.; 1: No. 1, 29-33(Aug 1973).

The question of ownership has been a major deterrent to the development of geothermal resources in the United States. Federal legislation says that geothermal rights are a separate entity on federally administered lands. The Geothermal Steam Act of 1970 says that geothermal steam and associated geothermal resources are the products of geothermal processes in geothermal formations. The references to steam, hot water, and hot brines clearly indicate that Congress believes that the word "geothermal" implies the upper end of a temperature scale—but which scale is not specified, nor are we told at what point non-geothermal leaves off and geothermal begins. Researchers differ on classification of water according to temperature. Others make the division at logical temperatures, depending on their interests. Renewability and the question of rights are discussed. (MCW)

15040 GEOTHERMAL GEOPRESSURE RESOURCES AND PROBLEMS OF THE GULF COAST. Romans, W. A. Geotherm. Energy Mag.; 1: No. 1, 39-42(Aug 1973).

Technology exists to pump large quantities of water up to pressures of 3500 to 4000 lbs/in^2 for supercritical boilers in fossil-fueled steam power plants. This pump experience can be applied to a high-pressure water turbine that would extract the pressure energy from the geopressured fluid and discharge the fluid at conditions of pressure and temperature such that its thermal energy could be extracted. Geopressured fluids are normally saturated with methane and could be economically recovered. Hot interstitial water in deep overpressured sedimentary basins of greater-than-normal temperatures exist in the Gulf Coast from the Rio Grande to eastern Mississippi. The geology and hydrology of the region are reviewed. Abundant data are available for geopressured gas reservoirs. With favorable conditions, it is expected that wells could be made to produce 3 to 5 million gallons/day of water at 350 to 400°F, having a closed-in pressure at the well head of 4,000 to 5,000 psig, the water containing less than 10,000 mg/l dissolved solids, and 0.3 to 1.0 standard cubic feet of hydrocarbon gas per gallon of water. (MCW)

15041 GEOTHERMAL POWER GENERATION USING THE BINARY CYCLE. Holt, B.; Hutchinson, A. J. L.; Cortez, D. S. Geothermal. Energy Mag.; 1: No. 1, 45-58(Aug 1973).

Geothermal resources of the world are comparable in magnitude to fossil fuel and nuclear energy resources. It is evident that the technology exists to exploit economically many of the world's known geothermal reservoirs and that the impact on the environment will be minimal. A flowsheet for a typical binary power cycle is shown. The geothermal fluid is flashed and steam is flashed and steam is separated from the hot brine. Both streams are used to heat and vaporize the power fluid that is passed through a turboexpander and condensed with cooling water. The power fluid is then pumped to the upper working pressure and reheated to complete the cycle. The brine may be reinjected and the steam condensate used for cooling tower makeup, sold as fresh water, or reinjected with the brine. At the San Diego Gas and Electric plant the working fluid will be isobutane that will be heated by flashed steam and brine and condensed with cooling water. No expansion turbine or generator will be installed initially. (MCW)

15042 HYDROGENATION OF COAL. Mukherjee, D. K.; Chowdhury, P. B.; Sama, J. K.; Basu, A. N.; Basak, N. G.; Lahiri, A. (to Council of Scientific Industrial Research). US Patent 3,775,286. 27 Nov 1973. Filed date 7 Sep 1971. 6p.

A process is described of catalytic hydrogenation of coal. A water-soluble iron salt (chloride, nitrate, sulphate) is impregnated into discrete coal particles, chemically converting such water-soluble iron salt into iron oxide and generating activated iron oxide catalyst by subjecting the iron oxide-coated coal particles to pressure–temperature conditions in a hydrogen-hydrogen sulfide atmosphere. (auth)

15043 LAST ROADBLOCKS TO NEW ENERGY CONVERSION PROJECTS. Lattin, C. P. Jr. Weld. J. (N.Y.); 52: No. 12, 800-803(Dec 1973).

Aspects of engineering and construction capabilities as related to improving energy production are reviewed. It is noted that a potential roadblock to new energy conversion projects is the improper allocation of engineering and construction manpower and supporting equipment. Current conditions of equipment materials

availability are reviewed along with the status of engineering and skilled labor manpower pools. Methods for proper direction of manpower and proper use of materials and equipment are suggested. (JRD)

15044 GAS TURBINES WITH HEAT EXCHANGER AND WATER INJECTION IN THE COMPRESSED AIR. Gosparovic, I. N.; Stapersma, I. D. Combustion; 45: No. 6, 6-16(Dec 1973).

In gas turbine plants with heat exchanger, water injection into the compressed air between the compressor and the heat exchanger only marginally increases the efficiency but it substantially raises output, regarded from the point of view of energy economics, by as much as 55% in two-shaft plants. The specific cost is thus reduced as compared with simple gas turbines without heat exchanger. Regulation of the water supply presents no difficulty. The transient behavior is discussed. The addition of water to the cycle reduces the emission of nitrogen oxides by at least half. (auth)

15045 OUR ELECTRICAL FUTURE: WILL EPRI MAKE A DIFFERENCE. Balzhiser, R. E. (Electric Power Research Inst., Palo Alto, CA). Pub. Util. Fortn.; 93: No. 1, 23-27(3 Jan 1974).

Oil and gas have supplied almost half of the electrical energy in recent years. Both are in short supply now, and the author feels a more reasonable and realistic position must be adopted on the use of coal and nuclear power, but both have been plagued by environmental and safety concerns. The present technology in conversion is discussed. The role that the Electric Power Research Institute can play in the overall national effort for electrical production by serving as a coordinator in the industry's collective efforts is discussed. (MCW)

15046 EXPERTS SPEAK ON UTILITY FINANCING. Pub. Util. Fortn.; 92: No. 7, 15-41(27 Sep 1973).

A selected panel has explored the general area of utility financing dealing with regulatory, bond, and interindustrial ratings and other rating factors such as interest during construction, price-earning ratios, and the importance of the allowance for funds used during construction. The cost of both nuclear and fossil fuel generating units will increase in coming years, due in part to additional facilities necessary to meet ecological requirements and in part to the effects of inflation on all cost. Public relations and customer service were discussed. (MCW)

15047 THYRISTOR VALVE IN HVDC TRANSMISSION. Karady, G.; Gilsig, T. (Hydro-Quebec Inst. of Research). IEEE (Inst. Elec. Electron. Eng.), Spectrum; 10: No. 12, 36-43(Dec 1973).

The application of thyristor valves rather than mercury-arc valves for rectification in high-voltage dc transmission systems has increased. Schemes in service include Eel River in New Brunswick, Canada, the Gotland extension in Sweden, and the Sakuma extension in Japan. Basic circuits, design, construction, and operation methods are discussed for the use of thyristor valves in HVDC transmission. (MCW)

15048 SOLAR DISTILLATION APPARATUS. Lovrich, J. US Patent 3,775,257. 27 Nov 1973. Filed date 27 Dec 1971. 4p.

A solar distillation apparatus for converting seawater into fresh water is described. A transparent dome condenses solar energy and heats seawater in a container beneath it. The periphery of the dome is provided with a continuous channel for conveying vaporized liquid into a condenser tank. Means are included for collecting rain water. A seawater supply tank is provided with a demand valve for feeding to a main heating chamber. The distilland is filtered and fed to an underground reservoir. (auth)

15049 IN SITU GASIFICATION OF COAL BY GAS FRACTURING. Rhoades, V. W. (to Cities Service Oil Co.). US Patent 3,775,073. 27 Nov 1973. Filed date 27 Aug 1971. 6p.

Two or more wells are drilled into a coal seam. The wells are completed so as to isolate all other strata from the coal seam and a radially extended horizontal fracture is directed by introduction of a first combustion supporting gas under hydraulic pressure so as to connect the wells communitively. A horizontally and vertically directed fracture network is formed within the coal system by ignition of the first combustion supporting gas. A second combustion supporting gas is subsequently injected through at least one well to form a combustion front that may be propagated through the fracture network to produce combustible gases and coal tar liquids. (auth)

15050 SHORT TERM ENERGY SHORTAGES. Hearings Before the Subcommittee on Energy of the Committee on Science and Astronautics, U.S. House of Representatives, Ninety-Third Congress, First Session, May 3, 8, 17, 1973. Washington, DC; Joint Committee on Atomic Energy (1973). 929p. GPO.

The causes and implications of the impending shortages of gasoline, heating oil, diesel fuel, jet fuel, and electricity were investigated at the May 3, 1973 hearings. Discussions and related data were presented on short-term fuel shortages and their effects on the electric utilities and the present situation in the regulated energy industries and its effects on energy R&D. The statement of the national oil jobbers council is presented in an appendix. (MCW)

15051 ENERGY OUTLOOK FOR THE 1980's. A Study Prepared for the Use of the Subcommittee on Economic Progress of the Joint Economic Committee, Ninety-Third Congress, First Session, by W. N. Peach, December 17, 1973. Washington, DC; Joint Committee on Atomic Energy (1973). 43p. GPO.

The prospects for developing energy resources in the United States are examined in the overview providing policymakers and the public much needed perspectives on the long-term energy outlook. The resources that can contribute to such expansion include coal; offshore production of oil and gas; Alaskan oil and gas; oil shale deposits; nuclear energy; geothermal energy; and Canadian tar sands. Possible improvements discussed include improved transportation, more intensive extraction of oil, and better conservation. (MCW)

15052 ENERGY RESEARCH AND DEVELOPMENT AND SPACE TECHNOLOGY. Hearings Before the Subcommittee on Space Science and Applications and Subcommittee on Energy of the Committee on Science and Astronautics, U.S. House of Representatives, Ninety-Third Congress, First Session, May 7, 22, and 24, 1973. Washington, DC; Joint Committee on Atomic Energy (1973). 573p. GPO.

Congressman James Symington was chairman of the Subcommittee on Space Science and Applications of the House Committee on Science and Astronautics. Congressman Mike McCormack was present at the proceedings and witnesses presented data on the development of long-term fuel supplies, a continued search for more reliable and more efficient designs of plants, and the optimization of the impact on society in the use of energy for such things as food, shelter, clothing, heat, light, health, recreation, travel, and education. Then, general problems of the byproducts of the energy-producing processes are examined including fly ash, sulfur oxides, nitrogen, oxides, warm water, esthetics, strip mining, and radiation. Representatives from the utilities, national laboratories, gas companies, universities, environmental councils, space agencies, and communication companies presented the data covering all aspects of energy research. (MCW)

15053 SOLAR ENERGY FOR HEATING AND COOLING. Hearings Before the Subcommittee on Energy of the Committee on Science and Astronautics, U.S. House of Representatives, Ninety-Third Congress, First Session, June 7 and 12, 1973. Washington, DC; Joint Committee on Atomic Energy (1973). 295p. GPO.

Testimony was first presented on the inexhaustible energy source of the Sun used for generation of electricity in central power stations. Now the witnesses discussed the harnessing of the power of the Sun for heating and cooling. Prof. George Löf, director of Solar Energy Applications Laboratory of Colorado State University, the first speaker at these hearings says that although the technology is still in the experimental stages, "the heating and cooling of buildings by solar energy is technically feasible and is closely approaching economic viability". Dr. Löf and Dr. James Comly were the witnesses presenting information on June 7, and Walter A. Meisen, Fred S. Dubin, and Ralph J. Johnson presented statements on June 12, 1973. Additional information for the record is presented from sixteen statements by representatives from government agencies, utilities, universities, engineering firms, architectural firms, homebuilders, and comfort cooling companies. (MCW)

15054 ENERGY FACTS. Prepared for the Subcommittee on Energy of the Committee on Science and Astronautics, U.S. House of Representatives, Ninety-Third Congress, First Session, by the Science Policy Research Division, Congressional Research Service, Library of Congress, November 1973. Washington, DC; Joint Committee on Atomic Energy (1973). 558p. GPO.

The handbook is an updated and improved version of "Energy–The Ultimate Resource", prepared for the Task Force on Energy of the Subcommittee on Science, Research, and Development during the 92nd Congress. Energy Facts contains a selection of United States and foreign energy statistics, statistical tables on most common and some unconventional energy sources. The tables and graphs are grouped by resources, production, consumption and demand, energy and gross national product, research and development. The appendix contains a glossary of energy-related terms, a definition of the energy unit most commonly used in the United States, a list of abbreviations, and appropriate conversion factors. (MCW)

15055 AMERICA'S ENERGY POTENTIAL: A SUMMARY AND EXPLANATION PREPARED BY CONGRESSMAN MORRIS K. UDALL, CHAIRMAN, SUBCOMMITTEE ON THE ENVIRONMENT FOR USE OF THE COMMITTEE ON INTERIOR AND INSULAR AFFAIRS OF THE U.S. HOUSE OF REPRESENTATIVES, NINETY-THIRD CONGRESS, FIRST SESSION, OCTOBER 1973. Washington,

DC; Joint Committee on Atomic Energy (1973). 22p. GPO.

The survey reports the confirmation of the existence of two energy crises: the first results from an inability to extract known resources at a sufficient rate, already made evident by the gasoline and heat oil shortages. The longer-term crisis involves the ultimate exhaustion of fossil fuel resources and can be expected to occur around the end of the century. The status and outlook and what options are available to alleviate the developing crises are examined for oil and gas; coal; nuclear energy; solar energy; indirect solar applications of photosynthesis, wind energy, ocean thermal gradients, and conversion of waste materials; and geothermal energy. (MCW)

15056 NATIONAL FUELS AND ENERGY CONSERVATION ACT OF 1973. Report on the Senate Committee on Commerce, Ninety-Third Congress, First Session, November 16, 1973. Washington, DC; Joint Committee on Atomic Energy (1973). 177p. GPO.

The purpose of the bill is to declare a national policy of conserving energy resources through more efficient conversion and use, to make energy conservation an integral part of all programs of the federal government, and to encourage an energy conservation ethic among American industry and the consuming public. Agency comments on Section 13 dealing with the authorization of a research program for an alternative propulsion system for automotive vehicles in commerce are published. Several provisions of the bill are intended to improve the energy efficiency of major household appliances, central heating and air conditioning systems, automobiles and other forms of transportation, while at the same time creating consumer awareness regarding the potential for saving energy and money by more informed purchase decisions and habits. These provisions require disclosure of estimated annual operating costs of major energy-consuming products. (MCW)

15057 ENERGY EMERGENCY LEGISLATION. Part 1. Hearing Before the Committee on Interior and Insular Affairs, United States Senate, Ninety-Third Congress, First Session. Pursuant to S. Res. 45 a National Fuels and Energy Policy Study, November 8, 1973. Washington, DC; Joint Committee on Atomic Energy (1973). 364p. GPO $2.35.

The publication is a background document for the National Fuels and Energy Policy Study authorized by Senate Resolution 45, introduced on Feb. 4, 1971, and considered, amended, and agreed to by the Senate on May 3, 1971. The document includes information necessary for the formulation of a long-term National Energy Policy that assures the continued welfare of the Nation, including balanced growth, safeguarding and enhancing the quality of the environment, and national security. Statements by 29 government or national organizations are presented. Additional information includes data on problems in achieving national goals caused by delay in implementation of necessary projects. Two documents from the National Association of Manufacturers, "A National Energy Policy" and "Instruction Manual for Survey of Industrial Energy Consumers" are presented. A staff report from the Federal Power Commission entitled "The Potential for Conversion of Oil-Fired and Gas-Fired Electric Generating Units to Use of Coal" is presented. (MCW)

15058 ENERGY COST OF AUTOMOBILES. Berry, R. S.; Fels, M. F. (Univ. of Chicago). Bull. At. Sci.; 29: No. 10, 11-17; 58-60(Dec 1973).

One of the consequences of the energy crisis has been a heightened interest in the amounts of energy we use for industrial processes. A conspicuous one is the manufacture of automobiles. The total free energy consumed in manufacture of a 1967 auto is ~37,275 kWh. The immediate purpose of the study was to provide the Institute of Environmental Quality of State of Illinois with assistance in making decisions on the disposal of automobile hulks and of solid waste in general. In a larger context, the analysis examines one aspect of how we use materials and energy from a thermodynamic point of view. The study is a pioneering effort in a new field of energy analysis. Its significance is illustrated by only one of its conclusions—that recycling junked autos that scarify our landscape and reusing the scrap in the manufacture of new ones would achieve dramatic reductions in total power consumption. (MCW)

15059 GEOTHERMAL ENERGY. Review of Research and Development. Armstead, H. C. H. (ed.). Paris; United Nations Educational, Scientific and Cultural Organization (1973). 186p. Unipub, Inc., New York, $16.00.

Following a general review of what geothermal energy is, fourteen abstracts were prepared from papers on exploration, winning, utilization, corrosion control, economics, and management of geothermal energy. (MCW)

For abstracts of individual papers see: 15060–15073.

15060 BASIC THEORIES. Bullard, E. (Cambridge Univ., Eng.). pp 19-29 of Geothermal Energy. Armstead, H. C. H. (ed.). Paris; United Nations Educational, Scientific and Cultural Organization (1973).

A brief account is given of the structure of the Earth and of the processes going on within, particularly of the generation and transport of heat. New ideas have recently evolved and the views of the successful revolutionaries are adopted: those of the remnant defending the traditional position cannot be explained at every point. Topics studied include crust, mantle and core; underground temperatures and heat flow; the source of the heat; volcanoes, ridges and island arcs; the mechanism of plate motion; and the transfer of heat to the surface. (MCW)

15061 ROLE OF GEOLOGY AND HYDROLOGY IN GEOTHERMAL EXPLORATION. McNitt, J. R. (United Nations, New York). pp 33-40 of Geothermal Energy. Armstead, H. C. H. (ed.). Paris; United Nations Educational, Scientific and Cultural Organization (1973).

The application of geology and hydrology to the exploration of geothermal resources is described. The bases on which geologic decisions are made through the successive phases of an exploration project are followed in sections entitled: selection of a region for reconnaissance; selection of prospect areas; selection of drill sites; and drilling and testing. (45 references) (MCW)

15062 GEOPHYSICAL METHODS IN GEOTHERMAL EXPLORATION. Banwell, C. J. pp 41-48 of Geothermal Energy. Armstead, H. C. H. (ed.). Paris; United Nations Educational, Scientific and Cultural Organization (1973).

Geophysical prospecting is the art of detecting and interpreting anomalies in the local pattern of certain physical quantities, as measured by suitable sensing equipment and techniques. It must proceed in close coordination with geology, hydrology, and geochemistry, so that physical measurements may constantly be interpreted and checked. Preliminary evidence of a geothermal field; world distribution of hydrothermal systems, and the preliminary data required are discussed. Four stages of the exploration survey are described, and then the effects of exploitation on the surrounding area are discussed. (MCW)

15063 GEOCHEMICAL METHODS IN GEOTHERMAL EXPLORATION. Sigvaldason, G. E. (Univ. of Iceland, Reykjavik). pp 49-59 of Geothermal Energy. Armstead, H. C. H. (ed.). Paris; United Nations Educational, Scientific and Cultural Organization (1973).

Geochemical methods are used in prospecting for potential geothermal exploitation, and chemical data on natural discharge from thermal areas serve as an important guide during subsurface exploration. As drilling proceeds, chemical analysis of deep thermal fluids provides information on flow patterns of water and assists in selecting improved drilling sites. During production, testing, and utilization, chemistry provides an efficient and inexpensive tool to detect minor and major changes in the reservoir with regard to temperature and water levels. Chemical analyses of waters and gases from various world areas where geothermal exploration is occurring are tabulated. (49 references) (MCW)

15064 STRUCTURE AND BEHAVIOR OF GEOTHERMAL FIELDS. Facca, G. pp 61-69 of Geothermal Energy. Armstead, H. C. H. (ed.). Paris; United Nations Educational, Scientific and Cultural Organization (1973).

Basic models of a geothermal steam field and low-temperature hot-water field are described from geological, geochemical, and geophysical exploration data. Then the Geysers geothermal field, California; the Otake geothermal field, Japan; and the Larderello geothermal field, Italy are classified to see how they generally conform to wet steam, dry steam, or hot water fields. (MCW)

15065 DRILLING FOR GEOTHERMAL STEAM AND HOT WATER. Matsuo, K. (Geothermal Energy Association, Tokyo). pp 73-83 of Geothermal Energy. Armstead, H. C. H. (ed.). Paris; United Nations Educational, Scientific and Cultural Organization (1973).

A method using rotary drilling for geothermal steam and hot water is described. Drilling with mud is the most common method, but air drilling is faster and cheaper. Geothermal wells are generally drilled with standard rigs as used for crude oil and natural gas. Well surveys, well spacing, safety installations and precautions, and well repairs are discussed. (25 references) (MCW)

15066 WELL MEASUREMENTS. Dench, N. D. (Ministry of Works, Wellington, N. Z.). pp 85-96 of Geothermal Energy. Armstead, H. C. H. (ed.). Paris; United Nations Educational, Scientific and Cultural Organization (1973).

Geothermal well fluid measurements are made for the basic study of a natural resource; assessment of an underground thermal reservoir for possible exploitation; assistance in drilling operations; appraisal of individual wells for production; mechanical

engineering design requirements, including safety of equipment and personnel; legal requirements for ownership, safety, or waste disposal; fluid sales; and plant operation. Measurements include reservoir investigation of size, permeability and temperature, and fluid composition and pressure; well flow characteristics of temperatures and pressures and the corresponding flow rates of steam, hot water, and gas; downhole engineering data of casing condition, mineral deposition, or levels of permeability. (33 references) (MCW)

15067 COLLECTION AND TRANSMISSION OF GEOTHERMAL FLUIDS. Smith, J. H. (Ministry of Works, Wellington, N. Z.). pp 97-106 of Geothermal Energy. Armstead, H. C. H. (ed.). Paris; United Nations Educational, Scientific and Cultural Organization (1973).

The collection and transmission of geothermal fluids may include hot water, steam, or a steam/water mixture if separation is effected at the plant instead of at the wellheads. The fluid produced most usually contains incondensable gases (typically CO_2 and H_2S with minor amounts of other gases), the proportion of gas sometimes being so high that economic utilization is not feasible. Economic feasibility also depends on the presence of rock fragments and the chemical composition of the water. Water contained in steam can also be considered an impurity. The engineering schemes for hot water, steam, and the two-phase transmission are described. (30 references) (MCW)

15068 GEOTHERMAL POWER. Wood, B. pp 109-121 of Geothermal Energy. Armstead, H. C. H. (ed.). Paris; United Nations Educational, Scientific and Cultural Organization (1973).

Geothermal energy is used for district heating, industry, and other heating applications, but emphasis is on power generation. The geothermal resources have to be exploited where they occur. Electric power generation at the site may then be transmitted. Geothermal power stations include Larderello, Italy; Wairakei and Kawerau in New Zealand; The Geysers and Salton Sea in California, USA; Pauzhetka and Paratunka in the USSR; Matsukawa and Otake in Japan; Pathé and Mexicali in Mexico; and Akureyri in Iceland. (MCW)

15069 GEOTHERMAL DISTRICT HEATING. Einarsson, S. S. (Vermir H/F, Reykjavik). pp 123-134 of Geothermal Energy. Armstead, H. C. H. (ed.). Paris; United Nations Educational, Scientific and Cultural Organization (1973).

A history of the application of geothermal energy for heating of houses is discussed for Iceland, Hungary, Japan, New Zealand, and USSR. The economics and technical aspects of the systems are described. The development of the geothermal areas feeding the system in Reykjavik is described, and then principal data regarding the geothermal district heating system are given. The Reykjavik system saves about 150,000 tons of oil annually that would have had to be imported, and the annual cost of heating for the customers is only 60% of the cost of heating with oil. (20 references) (MCW)

15070 INDUSTRIAL AND OTHER APPLICATIONS OF GEOTHERMAL ENERGY (EXCEPT POWER PRODUCTION AND DISTRICT HEATING). Lindal, B. pp 135-148 of Geothermal Energy. Armstead, H. C. H. (ed.). Paris; United Nations Educational, Scientific and Cultural Organization (1973).

Industrial applications of geothermal energy are discussed for pulp, paper, wood, sugar, boric acid, salts from seawater, heavy water, fresh water, diatomaceous earths, production of alumina from bauxite, and many other mining processes. The reclamation of minerals and other materials from geothermal fluids is feasible. Agricultural applications include greenhouse and soil warming, animal husbandry and other farm uses, and fish hatching and breeding. Recreational and health applications are described. Usually the main objective will involve some kind of evaporation, while the side uses may be drying, simple process heating, refrigeration, heating of industrial buildings, or the production of electrical power for the plant. (43 references) (MCW)

15071 CORROSION CONTROL IN GEOTHERMAL SYSTEMS. Marshall, T.; Braithwaite, W. R. pp 151-160 of Geothermal Energy. Armstead, H. C. H. (ed.). Paris; United Nations Educational, Scientific and Cultural Organization (1973).

The main problems of corrosion control in the design and operation of systems for the utilization of geothermal fluids involve interactions between chemical factors, physical factors such as temperature and stress, and the various materials of construction. The most common impurities encountered in geothermal fluids are silica, chlorides, fluorides, borates, sulfates, carbonates, sodium, potassium, lithium, calcium, magnesium, ammonium, hydrogen sulfide, and carbon dioxide. The nongaseous impurities are usually of major significance in water-phase corrosion in geothermal systems, while the gaseous impurities are usually of major significance in steam-phase, condensate and atmospheric corrosion. (50 references) (MCW)

15072 GEOTHERMAL ECONOMICS. Christopher, H.; Armstead, H. pp 161-174 of Geothermal Energy. Armstead, H. C. H. (ed.). Paris; United Nations Educational, Scientific and Cultural Organization (1973).

An attempt is made to assess representative costs applicable to a typical developed geothermal field. Geothermal heat is recovered with a fixed component in price for establishing production costs, no variable component. Limitations are imposed by location. There may be occasions where the availability is nullified by detrimental effects such as poisoned waste fluids. Geothermal heat may be obtained without insoluble technical problems at costs that are far less than for any other form of heat, and of an acceptable grade, leading to cheap power, cheap industry, and sometimes to large savings in foreign currencies. (MCW)

15073 MANAGEMENT OF A GEOTHERMAL FIELD. Bolton, R. S. (Ministry of Works, Wellington, N. Z.). pp 175-184 of Geothermal Energy. Armstead, H. C. H. (ed.). Paris; United Nations Educational, Scientific and Cultural Organization (1973).

Methods of estimating the energy potential are discussed and some parameters affecting the potential include stored heat and natural heat flow. The methods and effects of exploitation are related to the potential for the recovery of the energy. The primary effects of exploitation are discussed and examples are cited for results at Wairakei, New Zealand; Larderello, Italy; and Laugarnes, Iceland. The secondary effects of exploitation include natural activity, ground movement, pollution, and chemical deposition. Chemical deposition can reduce output or be a problem for the disposal of waste water. Tourism is a secondary effect. Measurements and records are made, but results seem to bypass mathematical tools. Perhaps as more geothermal fields are exploited, theoretical and mathematical background will expand. (21 references) (MCW)

Information Handling

15074 SUBJECT CATEGORIES FOR INVENTIONS AS APPLIED TO NUCLEAR AND COMMERCIAL GEOPHYSICS. Dav, R. N. Geofiz. App.; No. 51, 151-159(1973). (In Russian).

Categories of the International Classification Inventors, German, English, and American, which include inventions relative to nuclear and commercial geophysics, are examined. Recommendations are given on the scanning and sampling of materials during patent investigations. (tr-auth)

Law

Refer also to abstract 15080.

15075 (STI/PUB-366) AGREEMENTS REGISTERED WITH THE INTERNATIONAL ATOMIC ENERGY AGENCY. Fifth Edition. Legal Series No. 3. (International Atomic Energy Agency, Vienna (Austria)). Oct 1973. 196p. IAEA $9.00.

Part I consists of a chronological list of all agreements registered with the IAEA up to Dec. 31, 1971, to which Agency registration numbers have been allocated to correspond with the dates of their entry into force. Part II lists chronologically agreements registered between Jan. 1, 1972 and June 30, 1973. Part III consists of a tabular presentation of the material contained in Part I, setting out the states that have concluded these agreements. Part III provides a key to identify all agreements that have been completed with the agency. An Annex to Part III contains a key to agreements concluded by the agency with international organizations and other parties. (MCW)

15076 INSURANCE ASPECTS OF THE PARIS CONVENTION FROM THE UK POINT OF VIEW. Campbell Miles, A. (British Insurance (Atomic Energy) Committee, London). (1973). vp.

From first international meeting on nuclear law: Nuclear Inter Jura 73; Karlsruhe, Ger. (11 Sep 1973).

The insurance aspects of the Paris Convention are reviewed. These aspects are then discussed from the point of view of the UK Nuclear Installation Acts of 1965 and 1969 in relation to nuclear installation licensee responsibility; emission of ionizing radiations from installations; financial security required; cover period; certificate of financial security; period of limitation; British form of act liability insurance policy; two or more installations; site of an installation; liability for on-site damage; and suppliers of goods and services. It was concluded that there are no particular difficulties or problems. (GE)

15077 LAW ON INDEMNITY FOR DAMAGE, CAUSED BY RUNNING NUCLEAR SHIPS. Sv. Forfattningssamling; No. 158, vp(5 Jun 1963). (In Swedish).

Definitions of the terms nuclear ship, holder of nuclear ship, nuclear accident, and nuclear fuel are given. The law states how

indemnity for damage following a nuclear accident is to be regulated. It also states how claims to indemnity are to be presented, and gives rules for insurance. The law will be valid as long as the atomic responsibility law of June 3, 1960 is valid. (Sweden)

15078 NEW ASPECTS OF THE INTERNATIONAL MARITIME LAW. Regulations for Nuclear Ships. de los Santos, A. (1973). vp. (In Spanish).

From first international meeting on nuclear law: Nuclear Inter Jura 73; Karlsruhe, Ger. (11 Sep 1973).

The necessity for regulations for nuclear ships due to their special risks is discussed. It is shown that the SOLAS Convention (London 1948 and 1960) and the Brussels Convention on the Liability of Operators of Nuclear Ships (1962 and 1971) are unsatisfactory. This situation leads to the fact that only bilateral agreements are made, which comprise parts of the above mentioned conventions. Recently the NEA of the OECD and the IAEA are making preparations for multilateral agreements, since bilateral agreements are only valid for one single ship during its stay in foreign territorial waters. The question of operations outside territorial waters is considered. (GE)

Management

15079 (BNL-50392) INNOVATION, INVENTION, AND PATENTS. Schaeffer, D. M. (Brookhaven National Lab., Upton, N. Y. (USA)). Oct 1973. Contract AT(30-1)-16. 18p. Dep. NTIS $4.00.

Brookhaven lecture series, number 107, January 19, 1972.

A general discussion of the patent process is given. Some examples of patent writing are discussed. (MOW)

15080 (FDA-74-8004) REPORT OF STATE AND LOCAL RADIOLOGICAL HEALTH PROGRAMS. Fiscal Year 1972. Miller, L. A. (Bureau of Radiological Health, Rockville, Md. (USA)). Aug 1973. 80p. NTIS. GPO $1.10.

This report is the twelfth of a series based on data collected during fiscal year reviews of 53 state and local radiological health programs. The resources and activities of state and local radiological health programs are presented and summarized from data collected as of June 30, 1972. Summary data are included for fiscal years 1967 through 1972. Resources include data on personnel, funds, and equipment. The program activity areas are basic planning and administration, x-ray survey and control, environmental surveillance, radioactive materials, electronic products, and other radiological health activities. (auth)

15081 (K-1846) DEVELOPMENT, IMPLEMENTATION, AND EFFECT OF A PREVENTIVE-MAINTENANCE SCHEDULING SYSTEM IN AN INDUSTRIAL PLANT. Byars, W. S. (Oak Ridge Gaseous Diffusion Plant, Tenn. (USA)). 19 Nov 1973. Contract W-7405-eng-26. 121p. Dep. NTIS $5.45.

Thesis.

A study was made of both the theoretical approach and the practical industrial approach to develop a preventive maintenance (PM) system for an industrial job shop environment. In many industries the data necessary for the theoretical approach is not available, and it is too costly to obtain prior to setting up a PM program. A system was developed that attempts to blend the analytical approach with the practical industrial approach in order to minimize maintenance costs by adjusting PM frequencies as a function of machine breakdowns and machine usage. A computer was used to schedule repetitive PM tasks and level workloads according to given criteria. A data-collection system was developed, and information from the system was used to adjust PM frequencies toward optimum intervals to minimize total maintenance costs. (auth)

15082 (NP-19887) RADIATION HEALTH AND SAFETY ANNUAL REPORT FOR THE YEAR ENDED 31st DECEMBER 1972. (New South Wales Univ., Kensington (Australia)). 1973. 17p. Dep. NTIS (U. S. Sales Only) $3.00.

Aspects of radiation health and safety under the auspices of the radiation protection officer are reviewed for the year 1972. Topics discussed include personnel monitoring, radioactive waste disposal, radiation incidents, radiation insurance, advisory services and research. Radioactive materials and apparatus received are listed together with materials on order. Film badge exposures are tabulated. (AT)

15083 AVAILABILITY OF NUCLEAR STANDARDS INFORMATION. Cottrell, W. B. (Oak Ridge National Lab., TN). Nucl. Eng. Des.; 25: No. 3, 441-448(1973).

A brief summary of the nuclear standards organizations in the United States and a discussion as to how such standards may be located are presented. Some 25 non-governmental organizations that may prepare nuclear standards are identified. The most important organization is the American National Standards Institute that not only prepares such standards but coordinates the standards work of others. The increasing activity of several government agencies, specifically the Atomic Energy Commission, Environmental Protection Agency, and the National Bureau of Standards is also noted. The annual Compilation of Nuclear Standards (Vols. 1 and 2) prepared by the Nuclear Safety Information Center is the best single source of such information, although many other sources--including relevant information centers, as well as published documents--are identified. (auth)

15084 RADIOLOGICAL PROTECTION IN THE UNIVERSITIES. Bush, D. (Univ. of Birmingham, Eng.). Radiol. Prot. Bull.; No. 5, 6-9(Oct 1973).

Attention is drawn to the diversity of radiation protection arrangements in UK universities. An outline is presented of the general practice in the organization of radiation protection, the application of legislation affecting universities, with reference to the uses of radioactive substances for research and teaching, and the range of potential hazards. Attention is drawn to the Association of University Radiation Protection Officers as a common meeting ground. (UK)

15085 PROGRAMME OF RESEARCH IN BIOLOGY-HEALTH PROTECTION IN THE EUROPEAN ECONOMIC COMMUNITIES. McLean, A. S. (National Radiological Protection Board, Harwell, Eng.). Radiol. Prot. Bull.; No. 5, 3-5(Oct 1973).

A brief note is presented concerning the 1973 redefinition of the aims of the joint Biology-Health Protection program in the light of the admittance of three new states to the European Community. The aims are to acquire and promote the scientific and technical knowledge necessary for the determination of permissible radiation levels in man and contamination of the environment, for keeping such knowledge up-to-date, and for the improvement, of the practical organization of radiation protection by the member states. The complementary program carried out to date by only Germany, Italy, and the Netherlands included studies on radioactive contaminants, with particular reference to the path which they follow to man and in the environment, on the effect of radiation on living matter, and on dosimetric methods and instruments. The various difficulties of participation in a multi-national research program are briefly outlined, with reference to UK participation. It is pointed out that the Commission will refund only 20 to 40% of a project's cost in return for management participation. (UK)

15086 CNEN ACTIVITIES OF 1972. Com. Naz. Energ. Nucl., Notiz.; 19: No. 8-9, 37-46(1973). (In Italian).

Mathematics and Computers

Refer also to abstract 12751.

15087 (AECL-4603) FORTRAN ORIENTED SIMULATION SYSTEM FOR THE GENERAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS. Carver, M. B. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). [nd]. 6p. (CONF-730704-3). Dep. NTIS (U.S. Sales Only) $3.00.

From computer simulation conference; Montreal, Canada (17 Jul 1973).

The traditional continuous simulation system is merely a program package which handles the integration of simultaneous ordinary differential equations, using standard integration algorithms. Such a program may be used to integrate partial differential equations only if the user first discretizes the equations in space, thus transforming them into an ordinary differential equation system. This is frequently an onerous task. A program designed to handle the solution of partial differential equations in a generalized manner is described. The user supplies the partial differential equations in a FORTRAN sub-routine together with all the necessary boundary conditions, and the program completes the solution automatically, using the method of discrete ordinates. In this method, each partial differential equation is converted into a set of coupled ordinary differential equations in time which are then integrated by a standard algorithm. The user may specify the number of spatial divisions, and whether three-point or five-point difference approximations to the spatial derivatives are to be used. The paper concludes with a parametric investigation of the accuracy obtained from different methods of spatial division by comparing computed results to analytical solutions. (auth)

15088 (CEA-CONF-2378) CONNECTION BETWEEN TECHNOLOGY AND MODELS USING COMPUTER ANALYSIS. Borel, J.; Merckel, G.; Monnier, J.; Saintot, P.; Vandorpe, D.; Sterne, M.; Maffei, M. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Lab. d'Electronique et de Technologie de l'Informatique). 2 Apr 1973. 25p. (CONF-730222-1). Dep. NTIS (U. S. Sales Only) $3.25.

From International solid state circuits conference; Philadelphia, Pennsylvania, USA (14 Feb 1973).

To make a correlation between electrical and technological parameters it is necessary to know accurately the shape of the doping profiles from which it is possible to compute electrical properties and then derive physical models. This is done through the use of two computer programs DIFFUSI and MODMAG II. (auth)

15089 (COO-1469-230) QUARTERLY TECHNICAL PROGRESS REPORT, APRIL–JUNE 1973. (Illinois Univ., Urbana (USA). Dept. of Computer Science). 1973. Contract AT(11-1)-1469. 117p. (COO-2118-47; UIUCDCS-QPR-73-2). Dep. NTIS $8.00.

A general review of research during this period is given for the following areas: (1) circuits, (2) hardware systems, (3) software systems, (4) image processing and pattern recognition, (5) mesh research project, (6) switching theory and logical design, (7) machine and software organization studies, (8) computer systems analysis, (9) numerical analysis, (10) theory of digital computer arithmetic, (11) automation of introductory computer science courses, and (12) general department information. (MOW)

15090 (HMI-B-134) PROCESS COMPUTER SYSTEM: COMPUTER-AIDED MEASUREMENT ELECTRONICS. Tasks, Structures, Programming, and Applications of Process Computers in Measurement, Testing, and Experimental Techniques and in Laboratory Automation. Klessmann, H.; Pangritz, R. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (F.R. Germany). Bereich Datenverarbeitung und Elektronik). Apr 1973. 196p. (In German). Dep. NTIS (U.S. Sales Only) $12.00.

Manuscripts of the lectures given by the staff of the Electronics Department of the Hahn–Meitner Institute, Berlin, at the Technical University of Berlin are presented. (GE)

15091 (IPP-6-121) STABILITY OF DIFFERENCE SCHEMES FOR INITIAL-VALUE PROBLEMS. Hoehn, W. (Max-Planck-Institut fuer Plasmaphysik, Garching/Munich (F.R. Germany)). Oct 1973. 22p. (In German). Dep. NTIS (U.S. Sales Only) $3.25.

To establish stability of difference schemes for quasi-linear initial-value problems, criteria derived from the amplification matrix are widely used, but they have not yet been extended to implicit schemes or to those with unsteady coefficients or unsteady solutions of the initial-value problem involved. This paper attempts to do so in the case of one space and one time variable. Difference operators are regarded as large matrices with non-zero elements near the main diagonal only. Their spectral norms have to be approximated by means of inequalities for the eigenvalues of, in general, similar matrices. For tridiagonal matrices such inequalities are proven. The method includes generalized eigenvalues needed for implicit difference schemes. (auth)

15092 (KFK-1845) COMPUTER SIMULATION METHODOLOGY. Workshop, 10–11 May 1973 in Karlsruhe. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Datenverarbeitung in der Technik; Stuttgart Univ. (TH) (F.R. Germany)). May 1973. 422p. (In German). Dep. NTIS (U.S. Sales Only) $23.25.

A workshop on "Computer Simulation Methodology" organized by the Institute of Data Processing in Technology of the Karlsruhe Nuclear Research Center and the Computer Science Department of the University of Stuttgart was held from May 10–11, 1973 at Karlsruhe. The workshop's aim was to provide for an intensive exchange of thoughts among simulation specialists on fundamental problems in computer simulation design and experiments. This report includes all papers presented at the workshop and gives a survey on the referees and their fields of activity. (auth)

15093 (SLA-73-1041) SIMPLE SIGNIFICANCE TESTS FOR INDEPENDENCE OF EVENTS. Mueller, F. W.; Ellefson, J. R. (Sandia Labs., Albuquerque, N. Mex. (USA)). Dec 1973. Contract AT(29-1)-789. 12p. Dep. NTIS $3.00.

Exact significance tests are presented for use with system test results to check independence assumptions inherent in probability assessments based on subsystem test results. (auth)

15094 (SIL-73-302) CALCULATION OF DISCRETE FOURIER TRANSFORMS. Nelson, D. B. (Sandia Labs., Livermore, Calif. (USA)). Dec 1973. Contract AT(29-1)-789. 24p. Dep. NTIS $3.25.

A brief review of continuous and discrete Fourier transform theory is presented followed by a discussion of the use of the Sandia Mathematical Program Library (SMPL), fast Fourier transform routine, FOURT. A method of data compression based on frequency domain decimation (time domain aliasing) is presented. Also included is a brief discussion of the use of the discrete Fourier transform for the computation of Fourier series coefficients. (auth)

15095 (UCRL-74915) NEW COMPUTER TECHNOLOGY TO BE APPLIED TO DECISION MAKING PROCESS. Fernbach, S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Aug 1973. 32p. (CONF-730964-1). Dep. NTIS $3.75.

From conference of the Society for Management Information Systems; Chicago, Illinois, USA (13 Sep 1973).

Much of what is presented here is indicative of our national trends in computing. To review and bring in the international scope at the same time, the following points are enumerated: 1. There are but few new ventures in the competition for the high performance end of the computer market. 2. The competition for the middle range of computers is very great internationally. 3. The number and varieties of minicomputers are growing at a phenomenal rate throughout the world. There is no question but that the number of manufacturers and number of systems built will continue to accelerate for some time to come. 4. In all these systems, because of rapid price decreases, memory size will increase. 5. Software is becoming more complex and will continue to do so. Most systems will be based on existing systems. 6. Peripherals will improve in performance at lower cost, but will remain of the same magnetic variety in large measure. 7. Networks are "in" today and probably will remain so for quite some time in the broad sense of the word. Computer utilities are a long way off—if every they materialize. (LMT)

15096 (Y-1920) COMPUTER SIMULATION STUDIES OF PARABOLIC INTERPOLATION CIRCUITRY. Davenport, C. M. (Oak Ridge Y-12 Plant, Tenn. (USA)). 28 Dec 1973. Contract W-7405-eng-26. 36p. Dep NTIS $4.00.

A computer-simulation study of parabolic interpolation circuitry for machine tool controllers was completed. Results showed that a tool center can be moved along any parabolic arc to within any realistic tolerance. Circuit design requirements were determined and input data required by the parabolic interpolators were defined. Simulation results showed that tool motion along a pronounced parabolic path would stay within a $\frac{1}{2}$-microinch tolerance. An application of the parabolic interpolation toward reducing the large input data volumes required by conventional numerical controllers was achieved. (auth)

Miscellaneous

15097 (ANL-7996, pp 78-91) ISOTOPE STUDIES (WITH PARTICULAR EMPHASIS ON BIOLOGICALLY INTERESTING SYSTEMS). Feb 1973.

In chemistry division annual report, July 1971–June 1972.

15098 (ANL-7996, pp 132-135) MOLECULAR SPECTROSCOPY. Feb 1973.

In chemistry division annual report, July 1971–June 1972.

15099 (ANL-7996, pp 165-166) APPLIED PROGRAMS. Feb 1973.

In chemistry division annual report, July 1971–June 1972.

15100 (BDX-613-534(Rev.)) EVALUATION OF HIGH-TEMPERATURE DIELECTRIC MATERIAL. Final Report. Daly, J. C. (Bendix Corp., Kansas City, Mo. (USA)). Nov 1973. Contract AT(29-1)-613. 51p. Dep. NTIS $5.45.

Laminated flat cables using Kapton film were fabricated; these cables withstood temperatures up to 1000°F (538°C) for 10 minutes and potentials as high as 20 to 30 kV dc. A superior polyimide adhesive, Thermostik-D', was originated in the Bendix Polymer Laboratory, and a moldable polyimide powder and a process for using it were developed. These materials exhibit electrical strengths up to 625 volts/mil (24 kV/mm) and temperature resistance as high as 850°F (454.4°C). (auth)

15101 (BDX-613-760(Rev.)) THIN-FILM MICROCIRCUIT SUBSTRATE METALLIZATION. Final Report. Forte, N. V. (Bendix Corp., Kansas City, Mo. (USA)). Sep 1973. Contract AT(29-1)-613. 80p. Dep. NTIS $5.45.

A thin-film technique for applying gold over tantalum-nitride-coated alumina substrates was developed to permit thermocompression bonding of fine wires, beam-lead devices, and lead frames. Satisfactory gold adhesion was obtained by depositing a thin layer of chromium over the tantalum nitride before depositing the gold. The system provides guidelines for fabricating hybrid microcircuits that contain beam-lead devices. (auth)

15102 (BDX-613-839(Rev.)) FLATPACK SOLDERING TO SOLDER-LEVELED PRINTED WIRING BOARDS. Final Report. Morris, R. S. (Bendix Corp., Kansas City, Mo. (USA)). Oct 1973. 29p. Dep. NTIS $4.00.

A suitable manufacturing process was developed to solder multilead flatpacks to solder-leveled printed wiring boards (pwb). Additional solder required on the solder-leveled boards was supplied by solder preforms applied to each lead. These preforms contain the proper amount of solder to prevent bridging between

flatpack leads or pwb solder pads. This process is slightly more time consuming than the conventional method of mounting flatpacks on unleveled tin/lead-plated boards by reflow soldering, but the increased cost is more than offset by the improved appearance and strength of the solder joints and by the improved solderability of solder-leveled boards as compared to that of unleveled tin/lead-plated boards after typical storage periods. (auth)

15103 (BDX-613-875(Rev.)) ELECTRODEPOSITION OF ALUMINUM FROM ETHER–HYDRIDE SOLUTIONS. Final Report. Clay, F. A. (Bendix Corp., Kansas City, Mo. (USA)). Nov 1973. Contract AT(29-1)-613. 48p. Dep. NTIS $4.00.

The development work on the electrodeposition of aluminum from ether–hydride solutions is reported. Solution preparation procedures, basic chemistry, materials of construction, physical properties of the deposit, alloy deposition, effects of contaminants, and the effects of various additives and electroforming studies are reported. The ether–hydride bath has proven to be a reliable system for electrodepositing aluminum coatings on a metallic substrate. (auth)

15104 (BDX-613-938) LOW-DENSITY FOAMS FOR VACUUM INSULATION. Richardson, W. E. (Bendix Corp., Kansas City, Mo. (USA)). Sep 1973. Contract AT(29-1)-613. 19p. Dep. NTIS $4.00.

An investigation to find an open cell foam polymer for vacuum insulation has shown an epoxy-modified isocyanurate foam to be superior to urea/formaldehyde foams. Though improved during the study, the urea/formaldehyde foams still had problems of being too friable, dimensionally unstable, and possessed of the odor of unreacted formaldehyde. Thermogravimetric and thermomechanical analyses showed the epoxy-modified isocyanurate foam to be more thermally and dimensionally stable than the urea/formaldehyde foams. (auth)

15105 (BDX-613-944(Rev.)) IMPACT TESTING OF MATERIALS USING AN EIGHT-INCH AIR GUN AND COMPUTER REDUCTION OF DATA. Thorne, L. F. (Bendix Corp., Kansas City, Mo. (USA)). Oct 1973. Contract AT(29-1)-613. 52p. Dep. NTIS $5.45.

A mechanical shock actuator has been converted into an air gun capable of firing 8-inch-diameter (20.32 cm) projectiles to velocities exceeding 1000 fps (304.8 m/s). This new capability has been used to study the effect of impact velocity upon the energy absorbed by crushable materials. Shock-pulse data is reduced by computer techniques and test results are displayed in either tabular or graphic format by use of the CDC 6600 Calcomp plotter. (auth)

15106 (BDX-613-959(Rev.)) MASK GENERATION. Schantz, L. E. (Bendix Corp., Kansas City, Mo. (USA)). Sep 1973. Contract AT(29-1)-613. 62p. Dep. NTIS $5.45.

Four specifications were written to describe requirements of microcircuit photomask generation and quality control. Processes developed were grouped under categories of layout and generation, inspection, serializing, and cleaning, handling, and storage. (auth)

15107 (BDX-613-964(Rev.)) IMPROVED WORK DIRECTORS. Final Report. Carter, R. C. (Bendix Corp., Kansas City, Mo. (USA)). Nov 1973. Contract AT(29-1)-613. 18p. Dep. NTIS $4.00.

Activities aimed at improving work directors which program the instructions required for fabricating printed wiring board assemblies included designing solid-state switching circuitry for improved reliability, evaluating interface cabling techniques, studying visual-aid display-lamp mounting, and packaging innovations for product interface and troubleshooting convenience. The prototype solid-state work director functions satisfactorily. Recommendations for the design and fabrication of future work directors include a wire-wrapped terminal construction technique and use of light-emitting diodes to replace conventional incandescent lamps. (auth)

15108 (BDX-613-971) IMPROVED RADIO-FREQUENCY POWER STANDARDS. Stone, D. W. (Bendix Corp., Kansas City, Mo. (USA)). Sep 1973. Contract AT(29-1)-613. 22p. Dep. NTIS $4.00.

Two types of Hewlett Packard radio-frequency power meters were modified to improve the accuracy of their calibration-factor-compensation circuits from 1 to 0.1%. The modification resulted in a continuously variable calibration-factor dial with a resolution of 0.01% and a 0.5% improvement in the confidence level of power measurements. (auth)

15109 (BDX-613-1007) GRINDING MINIATURE PINION GEARS. Stiles, R. W. (Bendix Corp., Kansas City, Mo. (USA)). Oct 1973. Contract AT(29-1)-613. 31p. Dep. NTIS $4.00.

Although grinding inherently produces a better involute form and finer surface finish than other basic gear-fabrication methods, equipment, and experience in grinding 120-pitch gears with 0.100-inch pitch diameter were not available when Bendix Kansas City placed a process development contract with the Fellows Company. Bendix had been producing a functional miniature gear by hobbing, but the required surface finish was borderline and burrs on the part were difficult to remove. As a result of this project, a repeatable process was developed for grinding the tooth form and maintaining a 16AA surface finish with minimum burrs. An experimental machine was used in this process development; production equipment is not yet available in U. S. industry for this process but could be developed. (auth)

15110 (BDX–613-1012) SOLUTION CONTROL FOR HYBRID MICROCIRCUIT ETCHING. Lantz, L. L. (Bendix Corp., Kansas City, Mo. (USA)). Oct 1973. Contract AT(29-1)-613. 14p. Dep. NTIS $4.00.

Methods were developed for monitoring the photoresistant developer and gold etchant used in hybrid microcircuit etching. The developer color, which darkens with use, was monitored using a spectrophotometric procedure. The gold concentration in the gold etch was found to be very critical to the etch rate. Measurement of solution density was found to be effective in monitoring the gold concentration. (auth)

15111 (BDX-613-1013) METHOD OF IMPROVING ANALOG COMPARATOR CALIBRATION ACCURACY. Doussard, J. R. (Bendix Corp., Kansas City, Mo. (USA)). Nov 1973. Contract AT(29-1)-613. 7p. Dep. NTIS $3.00.

Product performance specifications often require monitoring of signal lines for minimum and maximum dc levels and pulse amplitudes. Monitoring is usually done on a Go/No-Go basis since a recorded value is not required. This type of signal monitoring can be done with an analog-type voltage comparator. The integrated circuit analog voltage comparator is widely used in this application since it is both accurate and economical. The accuracy of the voltage comparator will depend on the accuracy of the instrumentation used in setting the comparator threshold level (limit value) and the comparator threshold stability. The threshold stability can be determined by recording the as-found threshold level during the calibration check. A closed-loop ramp-generator calibration technique has been developed to provide digital-voltmeter readout of the comparator threshold level. The as-found comparator threshold level is automatically determined during the calibration check when this calibration technique is employed. This technique minimizes the time spent in conducting the calibration and provides an accurate measurement of comparator hysteresis. (auth)

15112 (BNWL-tr–104) CONTRIBUTION TO THE STUDY OF THE COLD-HARDENING STABILITY OF AUSTENITIC STEELS, ESPECIALLY DURING CREEP TESTS: INFLUENCE OF ELEMENTS TO STABILIZE THE CARBON. Calvet, J. N.; Petrequin, P.; Weisz, M.; Badard, A. (CEA, 75 - Paris (France)). 26 Dec 1973. Translation by E. R. Appleby of CEA-CONF–2119. (CONF-721063–7). 46p. Dep. NTIS $4.50.

From Autumn meeting on metallurgy; Chatenay-Malabry, France (2 Oct 1972).

First, an attempt is made to define, for an austenitic stainless steel Z6 CND 18-13 (316), the temperature domains and the cold-hardening rates for which a marked advantage exists from the point of view of creep resistance with respect to the hyperquenched state. Then, an attempt is made to define, during static holds after cold-hardening at 20°C, the influence of carbon and stabilizing elements such as Ti and Nb on the cold-hardening stability characterized by the value for the traction properties at 20°C for steels of the type 23-6 CND 18-13. The experiment proves in effect that there is a direct parallelism between the resistance to softening by heat treatment after cold-hardening and the creep resistance of chrome–nickel austenitic steels. (11 tables, 18 figures, 19 references). (auth)

15113 (BNWL-tr-106) DETERMINATION OF THE DISCHARGE OF WELLS PARTIALLY PENETRATING THE FREE AQUIFER, SUNK IN ISOTROPIC AND ANISOTROPIC SOILS. Le Gourieres, D. Translated by E. R. Appleby from Bull. Int. Ass. Sci. Hydrol.; 17: 301-313(1972). 19p. Dep. NTIS $3.00.

Darcy's law and an hypothesis formulated from experimental considerations were used to establish a semi-empirical formula for the calculation of the discharge of partially penetrating wells of free aquifer sunk in isotropic soils. (auth)

15114 (BNWL-tr–107) SURFACE ROUGHNESS MEASUREMENTS ON THE INTERIOR SURFACE OF SEAMLESS, STRETCH-REDUCED TUBES OF CHROME–NICKEL STAINLESS STEELS. Skov, J.; Wolf, M. Translated by B. G. Russell from Stahl Eisen; 93: No. 19, 885-892(1973). 20p. Dep. NTIS $3.00.

Peak-to-valley height and degree of roughness were determined. Surface-finish quality was evaluated using a newly developed quality code figure (quality reduction points as a function of the probability of defects occurring). Accuracy of the testing and grading method on the basis of variable factors involved in the stretch-reducing process was evaluated. (auth)

15115 (CALT-822-55) ELECTRIC AND MAGNETIC PROPERTIES OF Pd–Mn–P AMORPHOUS ALLOYS. Marzwell, N. I. (California Inst. of Tech., Pasadena (USA). W. M. Keck Lab. of Engineering Materials). Nov 1973. Contract AT(04-3)-822. 62p. Dep. NTIS $5.25.

The electric and magnetic properties of amorphous Pd–Mn–P alloys were studied in the range of 15 to 38 at.% manganese at a constant phosphorus concentration of 23 at. % and keeping the metallic contents at $(Pd_{70}Mn_{30})_{100-y}P_y$ the concentration of phosphorus could vary from 17 to 26 at. %. The effect of the 3d band filling of the first transition metal group, the phosphorus concentration effect that acts as an electron donor, and the transition metal concentration effect were studied. (MCW)

15116 (CEA-CONF-2405) ARCHAEOLOGICAL SURVEYING BY HIGH-SENSITIVITY DIFFERENTIAL MAGNETOMETRY. Salvi, A.; Lemercier, D.; Lemercier, P.; Robach, F.; Colardelle, M. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Lab. d'Electronique et de Technologie de l'Informatique). 13 Jun 1973. 23p. (In French). (CONF-730575–6). Dep. NTIS (U. S. Sales Only) $3.25.

From international conference on application of nuclear data in the field of work of art; Rome–Venice, Italy (24 May 1973).

A double resonance magnetometer was developed for use in archaeological surveying and its operational characteristics are given. Its use in field operations is described. Examples are given of the application to archaeological surveying. (JSR)

15117 (CNEA-349) POTASSIUM DETERMINATION IN COMPLEX FLUORIDES. Suner, A. A.; Botbol, J.; de Batistoni, A. M. L. G.; Quesada, C. A. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Departamento de Quimica). 1973. 8p. (In Spanish). Dep. NTIS (U.S. Sales Only) $3.00.

A method for determination of potassium as potassium perchlorate in complex fluorides is described. The complex fluorides are absorbed on anionic ion exchange resin that also absorbs part of the free fluoride ion. Then the sample is evaporated with nitric acid and the potassium determined as perchlorate. Interferences in the method are caused by NH_4^+, Rb, Cs, V, Mn, Pb, and Bi. (auth)

15118 (CNEA-350) MASS SPECTRA OF ALFA FURFURYL MERCAPTAN BY ELECTRONIC IMPACT; MECHANISM OF IONIZATION AND FRAGMENTATION. Cretella, R. F.; Gonzalez, O. A.; Lombardo, C. E. (Comision Nacionale de Energia Atomica, Buenos Aires (Argentina)). 1973. 29p. (In Spanish). Dep. NTIS (U.S. Sales Only) $3.50.

15119 (CONF-711076-) PROCEEDINGS OF THE FIRST SOIL MICROCOMMUNITIES CONFERENCE, SYRACUSE, NEW YORK, OCTOBER 18–20, 1971. Dindal, D. L. (ed.). (State Univ. of New York, Syracuse, (USA). Coll. of Environmental Science and Forestry). 1973. 285p. Dep. NTIS $7.60.

From first soil microcommunities conference; Syracuse, New York, USA (18 Oct 1971).

Twenty-two papers discuss various components of soil ecosystems with emphasis on microcommunity components and their interactions. (CH)

15120 (CONF-730802-1) MULTI-SOURCE ATMOSPHERIC TRANSPORT MODEL FOR DEPOSITION OF TRACE CONTAMINANTS. Mills, M. T.; Reeves, M. (Union Carbide Corp., Oak Ridge, Tenn. (USA). Computer Sciences Div.). 1973. 16p. Dep. NTIS $3.00.

From 1st annual NSF trace contaminants conference; Oak Ridge, Tennessee, USA (8 Aug 1973).

A computer model was developed to predict the deposition rates within a watershed of toxic materials emitted from different types of sources. At present, the following source categories are included in the model: point (steam plant or incinerator), area (city or industrial development), line (auto, rail, or air traffic), and particulate resuspension (windblown mine tailings). The dispersal of pollutants from each of these sources is described in terms of the Gaussian plume model, modified to account for source depletion due to fallout and washout. (auth)

15121 (CONF-730802-2) OVERVIEW OF A UNIFIED TRANSPORT MODEL. Patterson, M. R.; Mankin, J. B.; Brooks, A. A. (Union Carbide Corp., Oak Ridge, Tenn. (USA). Computer Sciences Div.). 1973. 12p. Dep. NTIS $3.00.

From 1st annual NSF trace contaminants conference; Oak Ridge, Tennessee, USA (8 Aug 1973).

A computer model is being developed that couples atmospheric deposition of trace contaminants to a hydrologic transport mode. Physical transport, chemical exchange processes, and coupling of toxicant transport to biological-uptake and food-chain processes are actively being modeled. A brief summary of the programming considerations, coupling of the submodels, and the capabilities of the unified model is presented. (auth)

15122 (CONF-730802-3) COMPUTER MODEL FOR CHEMICAL EXCHANGE IN THE STREAM SYSTEM. Raridon, R. J.; Mills, M. T.; Huckabee, J. W. (Union Carbide Corp., Oak Ridge, Tenn. (USA). Computer Sciences Div.; Oak Ridge National Lab., Tenn. (USA)). 1973. 9p. Dep. NTIS $3.00.

From 1st annual NSF trace contaminants conference; Oak Ridge, Tennessee, USA (8 Aug 1973).

A computer model for chemical exchange was developed in order to trace the flow of toxic contaminants downstream from the point of injection. The model is able to treat variations in stream velocity and exchange parameters as a function of distance downstream. (CH)

15123 (CONF-730802-4) SOIL AND GROUND–WATER POLLUTANT TRANSPORT MODEL. Reeves, M.; Duguid, J. O. (Union Carbide Corp., Oak Ridge, Tenn. (USA). Computer Sciences Div.; Oak Ridge National Lab., Tenn. (USA)). 1973. 9p. Dep. NTIS $3.00.

From 1st annual NSF trace contaminants conference; Oak Ridge, Tennessee, USA (8 Aug 1973).

The transport equations for moisture flow and hydrodynamic dispersion of a dissolved constituent were solved in two dimensions by a finite-element Galerkin numerical technique. Applications to a small watershed and a seepage pit are presented. (auth)

15124 (COO-1105-147) SPIN–LATTICE RELAXATION AND ATOMIC MOTIONS IN LiF. Wagner, J. (Wisconsin Univ., Madison (USA)). 1970. 98p. Dep. NTIS $7.00.

Spin–lattice relaxation times of the ^7Li spins in LiF were investigated using pulsed NMR techniques to determine the dominant mechanisms contributing to the normal high-field relaxation, $1/T_1$, at laboratory fields of several kilogauss and also those contributing to the rotating-frame relaxation, $1/T_{1\rho}$, corresponding to effectively low fields obtained by keeping the spins saturated. The experiments exhibit the very long intrinsic T_1 of LiF, enabling one to achieve exceptional sensitivity to very dilute and very long-correlation-time interactions with defects and impurities and to study these interactions in the relatively low-temperature region, $T < 400°K$. Results are discussed for experiments performed below 280 K and above 280 K, and in the temperature range from 280 to 380 K the motion of bound vacancies as reflected in their pronounced effect on the rotating frame relaxation were observed. (MCW)

15125 (COO-1140-211) HIGH TEMPERATURE CHEMISTRY. Progress Report, November 1, 1972–October 31, 1973. Gilles, P. W. (Kansas Univ., Lawrence (USA). Dept. of Chemistry). 31 Oct 1973. Contract AT(11-1)-1140. 21p. Dep. NTIS $3.25.

For the titanium–oxygen system, reasonably good values for $D(TiO)$ and $D(TiO_2)$ are available; the extent of fragmentation of TiO^+ and TiO_2^+ are known; the range of nonstoichiometry in Ti_2O_3 was measured at high temperature; and the variation in the chemical potential of oxygen was studied between Ti_2O_3 and TiO_2. (DLC)

15126 (COO-1198-995) LOW-TEMPERATURE BULK MODULUS OF SOLID ARGON. Wilkins, R. W. (Illinois Univ., Urbana (USA)). Jun 1973. Contract AT(11-1)-1198. 133p. Dep. NTIS $8.75.

Thesis.

The lattice parameter of a free-standing argon crystal was measured as a function of pressure at constant temperature using a high-precision back-reflection x-ray camera. Low-temperature measurements cover the pressure range of 10 to 300 bar. These measurements, which are the first direct measurements on a free-standing argon crystal in this pressure range, give a $P = 0$, $T = 0$ bulk modulus of 28.8 ± 0.4 kbar. This value is in good agreement with the value obtained by extrapolating recent piston-displacement measurements to $P = 0$ and also with recent theoretical calculations that incorporate three-body forces. A survey of experimental and theoretical values of the bulk modulus and elastic constants of solid argon at higher temperatures is presented. (MCW)

15127 (COO-1198-996) EQUILIBRIUM VACANCY CONCENTRATION MEASUREMENTS IN SOLID ARGON. Schwalbe, L. A. (Illinois Univ., Urbana (USA)). Jun 1973. Contract AT(11-1)-1198. 67p. Dep. NTIS $5.50.

Thesis.

The direct technique of simultaneously measuring bulk and lattice expansion to determine equilibrium vacancy concentrations was applied to solid argon. The results indicate that vacancy

concentrations do not exceed 0.02% even at the highest temperatures. Although the data obtained were not sufficiently precise to allow unique values to be determined for the formation parameters, it would appear from semi-empirical considerations that both these results and previous ones, from the similar investigation of solid krypton, cannot be explained consistently within the context of presently existing theory. (auth)

15128 (COO-1198-1026) MAGNETISM IN Ni–Cu AND Co–Re SOLID SOLUTIONS. Mishra, S.; Hayes, E. J.; Tustison, R.; Beck, P. A. (Illinois Univ., Urbana (USA)). 1973. 3p. (CONF-730977-1). Dep. NTIS $3.00.

From international conference on disordered alloys; Strasbourg, France (Sep 1973).

Recent work with a virtually iron-free superparamagnetic Ni–Cu alloy resulted in the analysis of the magnetization measured as a function of field in the temperature range from 1.5 K to room temperature in terms of a field- and temperature-independent susceptibility and two Brillouin functions corresponding to average magnetic cluster moments of $\mu_1 = 5.3\mu_B$ and $\mu_2 = 23.2\mu_B$. Similar work was performed on an iron-free paramagnetic alloy and virtually iron-free ferromagnetic alloys with 42, 45, and 48 percent Ni. Results on Co–Re show the existence of a continuous solid solution phase field all the way from the low temperature modification of Co to Re. Moment assignments were determined. 'MCW)

15129 (COO-1332-84) EFFECT OF RADIO PACKAGES ON DUCKS. Gilmer, D. S.; Ball, I. J. Jr.; Cowardin, L. M.; Riechmann, J. H. (Minnesota Univ., Minneapolis (USA). James Ford Bell Museum of Natural History; Northern Prairie Wildlife Research Center, Jamestown, N. Dak. (USA)). 1973. 17p. Dep. NTIS $3.00.

The most clear-cut effect of breast-mounted radio packages on wild, free-flying ducks was an increase in comfort movements (preen, stretch, shake, etc.). However, the data suggest that instrumented birds may decrease the frequency of comfort movements and increase feeding on water as they become adjusted to the package. While predation rates did not seem excessive compared to Keith's (1961) study, it does appear that susceptibility to predation may increase as a result of adjustment to the package during the 3 weeks after attachment. For wood duck females, a lower-than-expected rate of direct recovery and rate of recapture in subsequent years indicate that radio packages may have had some effect on the long-term survival of these birds. (auth)

15130 (COO-1469-228) LASCOT: A LARGE SCREEN COLOR TELEVISION SYSTEM. Cooper, M. N. Illinois Univ., Urbana (USA). Dept. of Computer Science). Jun 1973. Contract AT(11-1)-1469. 51p. (UIUCDCS-R-581). Dep. NTIS $5.45.

Thesis.

The Large Screen Color Television System as proposed by Dr. W. J. Poppelbaum is a laser projection display which produces a color television picture on a large screen placed some distance away. Constructing an economical display system was the chief objective. Toward this end relatively inexpensive electromechanical mirrors are used for beam deflection. These mirrors are synchronized with the composite video. LASCOT uses a mixed-gas (argon–krypton) laser as its light source. The blue, green and red colored beams are intensity modulated by electro-optic light modulators (EOLMs). These EOLMs are driven by the blue, green and red picture signals derived from a standard commercial television receiver. These modulated beams are combined by means of dichroic mirrors. This composite beam has a color and hue which depends on the signals at the EOLMs. The composite beam is then deflected horizontally and vertically by means of the horizontal and vertical deflection mirrors. These deflection mirrors are synchronized to their respective synchronization signals which are derived from the television receiver. The picture is projected on a 3-foot by 4-foot high-gain screen. The overall resolution of the picture is in excess of 120 spots horizontally and 100 spots vertically. (auth)

15131 (COO-1469-232) STEREOMATRIX 3-D DISPLAY SYSTEM. Whiteside, S. E. (Illinois Univ., Urbana (USA). Dept. of Computer Science). Aug 1973. Contract AT(11-1)-1469. 44p. (UIUCDCS-R-73-590). Dep. NTIS $4.00.

STEREOMATRIX is a large-screen interactive 3-D laser display system which presents computer-generated wire figures stereoscopically. The presented image can be rotated, translated, and scaled by the system user and the perspective of the image is changed according to the position of the user. A cursor may be positioned in three dimensions to identify points and allows communication with the computer. (auth)

15132 (COO-2314-1(Rev.)) LOW NOISE AMPLIFIER WITH APPLICATION TO NOISE THERMOMETRY BETWEEN 300K AND 4K. Anderson, P. T.; Pipes, P. B. (Dartmouth Coll., Hanover, N.H. (USA). Dept. of Physics and Astronomy). 1972. Contract AT(11-1)-2314. 16p. Dep. NTIS $3.00.

A low-noise FET amplifier was constructed and applied to noise thermometry. The amplifier noise is less than 1 $nV/\sqrt{Hz}$ above 5 kHz. Temperatures between 300 and 4K were measured to better than 1% with a time constant of 5 seconds. The complete noise thermometer system is described. (auth)

15133 (FEI-393) CALCULATION OF THE ANISOTROPY OF TRANSFER MOMENTUM DURING TURBULENT FLOW OF LIQUID IN THE CHANNELS. Ibragimov, M. Kh.; Sabelev, G. I.; Tarin, A. A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1973. 30p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.50.

A method was proposed for the calculation of the coefficient of transfer momentum, making it possible to take into account the anisotropy of the transfer processes during turbulent flow of liquids in channels. Examples were given of the calculation of the anisotropy of the transfer momentum coefficient during flow in circular tubes and compound channels. The results of the calculation were compared with experimental data. (tr-auth)

15134 (INP-820) SPECTROSCOPIC STUDY OF VIBRATIONS IN CRYSTALLINE COMPOUNDS $[Me(NH_3)_6]X_2$. Grzybek, T.; Janik, J. A.; Janik, J. M.; Kulczycki, A.; Pytasz, G.; Sciesinska, E.; Sciesinski, J. (Institute of Nuclear Physics, Krakow (Poland)). Dec 1972. 27p. Dep. NTIS (U. S. Sales Only) $3.50.

Infrared and Raman spectra of $[Me(NH_3)_6]X_2$ crystals were measured for Me = Co, Ni, and X = Cl, Br, I, BF_4, ClO_4, PF_6. (DLC)

15135 (INP-830) SYSTEM OF THE AUTOMATIC TEMPERATURE CONTROL FOR A SMALL RESISTANCE FURNACE. Soltys, J.; Rzany, H.; Makar, R. (Institute of Nuclear Physics, Krakow (Poland)). 1973. 10p. (In Polish). Dep. NTIS (U.S. Sales Only) $3.00.

The working principle and design of an automatic temperature control for a small resistance furnace is described. The system allows programming of all three stages of the furnace operating cycle: heating rate, stabilization, and cooling rate. It consists of a small number of easily exchangeable parts. The system described is simple in construction, reliability, and operation. (auth)

15136 (IS-T-614) KINETICS OF SUBSTITUTION OF ETHYLBIS(DIMETHYLGLYOXIMATO)-AQUOCOBALT(III) BY HEXACYANOMETALLATES. Russell, R. (Ames Lab., Iowa (USA)). Dec 1973. Contract W-7405-eng-82. 90p. Dep. NTIS $6.50.

Thesis.

The formation of a 1:1 adduct between ethylaquocobaloxime, and $M(CN)_6^{n-}$ complexes for M = Fe(II), Fe(III), Co(III), and Cr(III) are reported. (DLC)

15137 (IS-T-616) NORMAL COORDINATE ANALYSIS OF SOME FIVE-MEMBERED HETEROCYCLIC RING MOLECULES. Williams, C. Jr. (Ames Lab., Iowa (USA)). Dec 1973. Contract W-7405-eng-82. 66p. Dep. NTIS $5.50.

Thesis.

Calculations were performed for the in-plane vibrations of furan, thiophene, selenophene, tellurophene, and deuterated furan and thiophene. (DLC)

15138 (ITF-73-84-P) OPTICAL ACTIVITY IN THE REGION OF LIGHT ABSORPTION DUE TO IMPURITY CENTERS. Fishchuk, I. I. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1973. 16p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.00.

The shape of dispersion curves of optical activity and circular dichroism in the region of light absorption due to impurity centers of a solid was studied, taking into account the change of the quasi-elastic constants during phototransitions. The general analytic expressions for the shape of curves are obtained, and their temperature dependence is investigated both in the phonon and non-phonon parts of the absorption spectrum. (auth)

15139 (ITF-73-114-P) THEORY OF PROTON ARRANGEMENT IN FERROELECTRIC AND ANTIFERROELECTRIC COMPOUNDS OF THE ORTHOPHOSPHATE TYPE. I. Levitskii, R. R.; Korinevskii, N. A.; Stasyuk, I. V. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1973. 42p. (In Russian). Dep. NTIS (U.S. Sales Only) $4.25.

The theory of ferroelectric compounds of orthophosphate type, based on configuration interactions, long-range correlations, and effects of tunneling of protons on bonds is proposed. The free energy of the proton subsystem is obtained and analyzed using the cluster expansion method. The possible proton arrangements are established, conditions of their existence are formulated (two of them are realized in crystals of KH_2PO_4 and $NH_4H_2PO_4$ type). It is shown that the long-range interactions are necessary to form an antipolarization state. Phase transitions and some questions of thermodynamics of deuterated crystals are studied on the basis of the obtained results. (tr-auth)

15140 (ITF-73-118-P) CALCULATION OF CONFIGURATIONAL INTEGRAL OF THE SYSTEM OF PARTICLES WITH ELECTROSTATIC INTERACTION. Golovko, M. F. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1973. 31p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.75.

The method of exact account of rotational degrees of freedom in the construction of statistical theory of particles of systems with noncentral interactions is developed. Common cluster expansions for thermodynamic and structure functions are obtained. These results are applied for mixed ion–dipole systems. (tr-auth)

15141 (JINR-E4-7373) INFLUENCE OF PHONONS ON LOW-TEMPERATURE PARAMAGNETIC RELAXATION. Buchbinder, I. L.; Paszkiewicz, T. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 20p. Dep. NTIS (U.S. Sales Only) $3.00.

The system of nonlinear equations of Provotorov and Bloch type is derived in rigorous manner in order to consider the role of phonons in the low-temperature paramagnetic relaxation. Near the end of the relaxation process, modified Bloch equations are equivalent to those of Brya and Wagner. The thermal phonons are considered in both collisionless and collision-dominated regimes. In the collision-dominated regime thermal phonons play a sufficient role in the relaxation process. (auth)

15142 (JINR-E4-7385) ELASTIC CONSTANTS IN THE ANHARMONIC FERROMAGNETIC CRYSTALS. Vukajlovic, F. R. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 16p. Dep. NTIS (U.S. Sales Only) $3.00.

The isothermal elastic constants for anharmonic ferromagnetic crystals are studied on the basis of self-consistent spin-phonon interaction theory. Using a long-wave method, an expression was obtained for elastic constants of an fcc lattice with nearest-neighbor interactions in the classical high-temperature region. A behavior of the elastic constants is found that is in qualitative agreement with experiment. (auth)

15143 (JINR-P4-7209) QUASICLASSICAL MODEL OF LIQUID HELIUM. Priezzhev, V. B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 20p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.00.

The wave function of the liquid helium ground state, calculated by variational method, is used in calculations of the phonon frequencies in the framework of the quasi-classical model. A satisfactory agreement is obtained with the experiment on thermal-neutron scattering without introduction of any adjustable parameters. (tr-auth)

15144 (JINR-P12-7441) SEARCH FOR THE REGULARITIES IN THE CHANGE OF PHYSICAL-CHEMICAL PROPERTIES OF THE ELEMENTS-HOMOLOGS AND THEIR COMPOUNDS. II. Energy of the Phase Shifts of the Halogen Compounds. Kolachkovski, A.; Norseev, Yu. V.; Nefedov, V. D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 12p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.00.

15145 (JUL-936-AC) IDENTIFICATION OF CRYSTAL POWDERS WITH THE ASTM DATA FILE. Guenther, M.; Freiburg, C. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Zentralinstitut fuer Analytische Chemie). Mar 1973. 72p. (In German). Dep. NTIS (U.S. Sales Only) $5.75.

Detailed explanations are given how to use the ASTM-PDF file (version 12, set 1-21) on an IBM/370-165 computer. Input may be done via IBM-2741 terminals. Examples of calculations are shown for calibration samples and successfully identified unknown samples. (auth)

15146 (KFK-1837) PHOTOPHYSICAL INVESTIGATIONS OF THE FIRST SINGLET STATE OF ANTHRACENE DERIVATIVES. Schoof, S. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Radiochemie). Sep 1973. 147p. (In German). Dep. NTIS (U. S. Sales Only) $9.50.

Thesis. Submitted to Technische Hochschule, Karlsruhe (West Germany).

The temperature dependence of the fluorescence properties of 30 anthracene derivatives were investigated in heptane. (auth)

15147 (KFK-1861) PHOTOCHEMISTRY OF BENZOIN ETHERS IN SOLUTION. Adam, S. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Radiochemie). Sep 1973. 118p. (In German). Dep. NTIS (U.S. Sales Only) $8.00.

Benzoin alkyl ethers dissociate into benzoyl- and α-alkoxybenzyl radicals on absorption of 366nm-light. This α-cleavage was demonstrated by ESR-spectroscopic identification of the primary radicals during irradiation. The quantum yield of photofragmentation is close to 1 and independent of the nature of the alkyl group, additional α-substituents and of the solvent. The quantum yield of benzoin ether consumption is only 0.42, because the starting material is partly reformed by recombination of the primary radicals. Product analysis by means of a GC/MS-combination yielded information on the secondary reactions of the radicals formed when deuterium marked benzoin methyl ethers were irradiated. In the absence of oxygen the benzoyl radicals react by dimerisation to benzil, by reaction with the alcohol used as solvent to form the corresponding benzoic acid ester, and by hydrogen abstraction from the starting material forming benzaldehyde. The α-methoxybenzyl radicals react by dimerisation to 1,2-dimethoxy-1,2-diphenylethane selectively. Additionally, high-boiling compounds form 20% of the final products. In the presence of oxygen the primary radicals are scavenged leading to peroxy radicals, causing an increase in the quantum yield of starting material consumption. In the secondary reactions the peroxy radicals react to perbenzoic acid, benzoic acid methyl ester, benzaldehyde, and benzaldehyde dimethyl acetal. In oxygen saturated solution the solvent (methanol) is decomposed to formic acid, hydrogen peroxide, performic acid, and formaldehyde. (auth)

15148 (KFK-1872) TABLES FOR USE IN PYROMETRY OF NONBLACK BODIES AT 650 NM WAVELENGTH. Karow, H. U. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Neutronenphysik und Reaktortechnik). Sep 1973. 64p. (In German). Dep. NTIS (U. S. Sales Only) $5.25.

Tables are given for the spectral radiation density of the black body at 650 nm wavelength, listed in the range 600 . . . 3600 C with 1°C steps. The tables will primarily be used for quick evaluation of the true temperature of a body from its black temperature, measured through a red filter. The emissivity of the body must be known. (tr-auth)

15149 (LA-5313) STUDY TO DETERMINE THE PHASE DIAGRAM OF THE BDNPA/F SYSTEM. Rivera, T. (Los Alamos Scientific Lab., N. Mex. (USA)). Nov 1973. Contract W-7405-eng-36. 3p. Dep. NTIS $4.00.

An experimental phase diagram for the bis(2,2-dinitropropyl) formal/bis(2,2-dinitropropyl) acetal system was obtained. (DLC)

15150 (LA-UR-73-1614) CELL PREPARATION AND STAINING FOR FLOW SYSTEMS. Crissman, H. A. (Los Alamos Scientific Lab., N. Mex. (USA)). 1973. Contract W-7405-eng-36. 20p. (CONF-731007-3). Dep. NTIS $3.00.

From 1st symposium on mammalian cells: probes and problems; Los Alamos, New Mexico, USA (17 Oct 1973).

Techniques are presented for dispersal and staining of cells in liquid suspension for subsequent microscopic analysis in flow systems. (CH)

15151 (LA-UR-73-1630) ELECTRON-BEAM-CONTROLLED GAS LASERS: DISCUSSION FROM THE ENGINEERING VIEWPOINT. Part II. Problems in the Electrical Design of Very High Energy Systems. Riepe, K. B.; Stapleton, R. E. (Los Alamos Scientific Lab., N. Mex. (USA)). 1973. 17p. (CONF-731114-40). Dep. NTIS $3.00.

From 5th symposium on engineering problems of fusion research; Princeton, New Jersey, USA (6 Nov 1973).

Some problem areas in the design of very-high-energy electron-beam-controlled short-pulse gas lasers are discussed. One of the prime areas of interest is the high-voltage pulse generators for driving the electron gun and gas pumping. The use of pulse-forming networks for improving energy-transfer efficiency is discussed. The use of thermionic cathode devices will require a large ac power installation. The properties of alternate electron sources (cold cathode and plasma cathode devices) are reviewed. The impact of laser beam energy density limitations on system geometry and electrical design are discussed last. (auth)

15152 (LA-UR-73-1650) SIGNALS GENERATED BY THE BINDING OF MULTIVALENT ANTIGENS TO LYMPHOCYTES. Bell, G. I. (Los Alamos Scientific Lab., N. Mex. (USA)). 1973. Contract W-7405-eng-36. 47p. (CONF-731007-2). Dep. NTIS $4.50.

From 1st symposium on mammalian cells: probes and problems; Los Alamos, New Mexico, USA (17 Oct 1973).

The signals that may be transmitted to a lymphocyte by the binding of antigen molecules to antibody-like receptors on the cell surface are classified into microsignals and macrosignals, and the role of each in cell behavior is discussed. (CH)

15153 (LBL-1891) HYDROGENOLYSIS OF CYCLOPROPANE ON PLATINUM STEPPED SINGLE CRYSTALS AT ATMOSPHERIC PRESSURE. Kahn, D. R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1973. Contract W-7405-eng-48. 176p. Dep. NTIS $11.00.

Thesis.

15154 (LBL-2263) RELATION OF PROCESSING PARAMETERS TO THE PROPERTIES OF LITHIUM FERRITE. Bandyopadhyay, G. (California Univ., Berkeley (USA). Lawrence

Berkeley Lab.). Nov 1973. Contract W-7405-eng-48. 80p. Dep. NTIS $6.25.
Thesis.
Lithium ferrite spinel ($LiFe_5O_8$) and related compositions were investigated to characterize the lithium and oxygen loss during heat treatment, and to determine the influence of sintering parameters, stoichiometry, and selected dopants on the densification, microstructure, and electrical and magnetic properties of the sintered material. Extensive thermogravimetric work in air was done on the system $LiFeO_2 - LiFe_5O_8 - Fe_2O_3$. Both lithium and oxygen loss were considered. The weight loss data for other ferrites were compared with that of the lithium ferrite system and the influence of the cation distribution on the weight loss kinetics was demonstrated. (MCW)

15155 (LBL-2270) ROLE OF DISLOCATION INTERACTION WITH SOLUTE ATOMS IN THE STRENGTHENING OF METALS. Syn, C. K. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1973. Contract W-7405-eng-48. 102p. Dep. NTIS $7.25.
Thesis.
In Part 1, the anisotropic elastic interaction energy of a straight edge dislocation with a substitutional solute atom of Ag or Cd in the matrix of Zn is computed. Then the force-displacement relation for rigid glide of the dislocation with respect to the solute atmosphere is calculated. In Part 2, the equilibrium configurations of dislocation lines in the shear stress fields of substitutional solute atoms distributed in square arrays and the flow stresses required to drive the dislocation lines through such arrays are computed by numerical methods and then compared with the predictions by the theories on the dislocation-point obstacle interaction. (MCW)

15156 (LBL-2447) MOLECULAR ARCHITECTURE AND DYNAMICS OF PHOSPHOLIPID DISPERSIONS. Michaelson, D. M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1973. Contract W-7405-eng-48. 101p. Dep. NTIS $7.25.
Thesis.

15157 (MHSMP-73-43-B) PETN RECRYSTALLIZATION STUDY. Period Covered: July–September 1973. Foster, P. A. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1973. 26p. Dep. NTIS $3.50.

15158 (MHSMP-73-43-D) SLOW PBX AND PLANE-WAVE LENS DEVELOPMENT. Period Covered: July–September 1973. Crutchmer, J. A. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1973. 10p. Dep. NTIS $3.00.
One batch of baratol was made; two billets were pressed for plane wave lenses. Plane wave lenses were fabricated and fired. (DLC)

15159 (MHSMP-73-43-E) PRESSING TECHNOLOGY. Period Covered: July–September 1973. Harrell, J. D. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1973. 7p. Dep. NTIS $3.00.
The physical properties of PBX 9404 can be improved by compacting at a pressure of 15 kpsi rather than the historically used 20 kpsi. (auth)

15160 (MHSMP-73-43-G) HIGH-TEMPERATURE X-RAY-DIFFRACTION. Period Covered: July–September 1973. Blair, C. C. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1973. Contract DA-11-173-AMC-487(A). 5p. Dep. NTIS $3.00.
Results are given for HMX, RDX, and HNAB. (DLC)

15161 (MHSMP-73-43-H) STUDY OF THE LONG-TERM CREEP OF A FILAMENT WOUND STRUCTURE. Final Report, July–September 1973. Hanes, L. D. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1973. 35p. Dep. NTIS $3.75.
A study was made to determine the room-temperature creep properties of an epoxy-wetted Fiberglas wrap. The data analysis for a six-month period shows that there is no detectable creep in the Fiberglas-epoxy within experimental error (±0.2%). (auth)

15162 (MHSMP-73-43-J) HE FRICTION SENSITIVITY. Period Covered: July–September 1973. Van Velkinburgh, J. H. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1973. Contract DA-11-173-AMC-487(A). 7p. Dep. NTIS $3.00.
Friction tests were conducted on PETN, LX-09, PBX-9404, and RX-04-EL. (DLC)

15163 (MHSMP-73-43-K) IMPROVEMENT OF PHOTOGRAPHIC AND OPTICAL SYSTEMS. Period Covered: July–September 1973. Kelly, S. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1973. 9p. Dep. NTIS $3.00.
A method of obtaining sensitometric data and plots using an analytical process is discussed. Calculations using this method agree well with results obtained by a manual method. A brief description is given of the modulation transfer function (MTF), how it is calculated, alternative methods for improving this calculation and an experimental MTF curve from a lens test system currently being evaluated. (auth)

15164 (MHSMP-73-43-L) COMPUTER MICRODENSITOMETER (DRUM SCANNER) SYSTEM. Period Covered: July–September 1973. Black, L. W. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1973. Contract DA-11-173-AMC-487(A). 2p. Dep. NTIS $3.00.
The drum scanner is a device which digitizes the optical density of a negative in spots of 25, 50, and 100μ. A 10 × 12-inch negative can be scanned in approximately 20 minutes. The enormous amount of data generated requires not only large storage capacity but fast response, as data are coming in at a rate of approximately 20,000 points per second. Programming of this system will provide a scheme for comparing points and printing out differences in optical density, location and size. This output will provide qualitative data from a lens radiograph. (auth)

15165 (MHSMP-73-43-M) THERMOPHYSICAL AND THERMOCHEMICAL PROPERTIES. Faubion, B. D. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1973. 5p. Dep. NTIS $3.00.
The symmetry properties of the molecular vibrations of four possible configurations of HNAB were calculated. (auth)

15166 (MHSMP-73-43-N) HE PARTICLE CHARACTERIZATION FOR QUALITY CONTROL. Giberson, R. C. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1973. 5p. Dep. NTIS $3.00.
PETN and LX-13 were analyzed for particle size and distribution. (DLC)

15167 (MHSMP-73-43-O) PARTICLE CHARACTERIZATION. Period Covered: July–September 1973. Duncan, A. A. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1973. 3p. Dep. NTIS $3.00.
Solubility studies involving HMX and EDNP were made using time lapse photography. Sieve analysis for each Paste Explosive (PEX) batch has been completed. (DLC)

15168 (MHSMP-73-43-P) LIGHT ENHANCEMENT FROM HIGH EXPLOSIVES. Period Covered: July–September 1973. Worley, R. D. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1973. 12p. Dep. NTIS $3.00.
The use of surface coating to enhance the light output was found not to be practical. Studies were made of light production in a flasher-gap. (DLC)

15169 (MHSMP-73-43-Q) STREAK CAMERA EVALUATION. Period Covered: July–September 1973. Laughter, E. D. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1973. 5p. Dep. NTIS $3.00.
This is the first quarterly report on a streak camera evaluation project, which when complete will yield calibrations of the Cordin 132 streak camera located at FS-4, the Beckman & Whitley 168 streak camera located at FS-5, the Beckman & Whitley 770 streak camera located at FS-20, the Cordin 132 Streak camera located at FS-22, and the Cordin 116 streak and framing camera, also located at FS-22. (auth)

15170 (MHSMP-73-43-R) MATHEMATICAL ANALYSIS OF HE DATA. Period Covered: July–September 1973. Ashcraft, R. W. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1973. 3p. Dep. NTIS $3.00.
Computer programs were written to analyze incomplete factorial data, density-log exposure data, and to calculate modulation transfer functions of lens systems from edge scan data. (auth)

15171 (MHSMP-73-43-S) DETERMINATION OF DEGREE OF CURE OF ISOTHERMALLY AGED LX-13. Clink, G. L. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1973. 24p. Dep. NTIS $3.25.

15172 (MHSMP-73-44-A) MECHANICAL PROPERTIES OF EXPLOSIVES. Period Covered: July–September 1973. Johnson, H. D. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1973. 10p. Dep. NTIS $3.00.
For Univ. of California, Livermore.
The stress relaxation of LX-04 was determined for three test conditions. (DLC)

15173 (MHSMP-73-44-B) HE FORMULATION. Period Covered: July–September 1973. Osborn, A. G.; Stallings, T. L. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1973. 15p. Dep. NTIS $3.00.
For Univ. of California, Livermore.
PETN samples were formulated into Extex and evaluated for

extrudability. Three skid-test parts were extrusion-cast from a new LLL ECX, RX-08-CH. Work is continuing on the paste explosive, RX-08-DR. RX-04-EK was blended and had a nominal composition of 96% HMX and 4% Estane. (DLC)

15174 (MHSMP-73-44-C) EXPLOSIVES PERFORMANCE AND SENSITIVITY. Period Covered: July–September 1973. Kramer, P. E. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1973. 4p. Dep. NTIS $3.00.

For Univ. of California, Livermore.

Tests were conducted on RX-04-EL (94/6% MHX/Estane). A test was also performed on LX-10-0 Lot 710-4. Examination of the 1% difference in expansion velocities between LLL and Pantex cylinder shots were continued. (DLC)

15175 (MHSMP-73-44-D) HE FRICTION SENSITIVITY. Period Covered: July–September 1973. van Velkinburgh, J. H. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1973. 7p. Dep. NTIS $3.00.

Instrumented skid tests was done on billets of RX-04-EL and RX-04-EK (94/6 and 96/4% HMX/Estane respectively). Friction machine tests were done on RX-04-EL. Skid tests were done on RX-08-CH, an ECX. (DLC)

15176 (MHSMP-73-44-E) THERMAL PROPERTIES, REACTIVITY, AND COMPATIBILITY. Period Covered: July–September 1973. Myers, L. C. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1973. 59p. Dep. NTIS $5.00.

For Univ. of California, Livermore.

Heat of fusion measurements were made on LX-13 grade PETN and on PETN from a fractional factorial experiment. Effects of recrystallization were studied in the fractional factorial experiment. Chemical reactivity test data are reported for combinations of various materials with LX-04, LX-09, LX-13, and PBX 9404. DTA thermograms were also run. (DLC)

15177 (MLM–2056) VACUUM CHUCK SYSTEM AND PROCESS FOR PRECISION GRINDING OF MOLDED PLASTIC PARTS. Draut, C. F.; Osborne, J. M. (Mound Lab., Miamisburg, Ohio (USA)). 3 Dec 1973. Contract AT-33-1-GEN-53. 21p. Dep. NTIS $4.00.

An inexpensive, vacuum-operated, part-holding fixture was designed and built at Mound Laboratory to hold molded plastic parts for precision surface grinding. The part-holding fixture, or vacuum chuck, incorporated a precision-ground substratum that supported the product and provided an accurate datum to meet product-design requirements in length and flatness. Interchangeable part-holding and positioning masks made the basic vacuum chuck and complementary grinding machine, retrofitted with a digital readout system, applicable for grinding various sized and shaped products. In a demonstration test, the vacuum chuck system and grinding process reduced the grinding and part-loading labor costs for one product by approximately 47% while producing the product within tolerence specifications. (auth)

15178 (ORNL-TM-4413) APPLICATION OF THE MARTIN EQUATION OF STATE TO THE THERMODYNAMIC PROPERTIES OF AMMONIA. Milora, S. L. (Oak Ridge National Lab., Tenn. (USA)). Dec 1973. Contract W-7405-eng-26. 25p. Dep. NTIS $3.25.

Thermodynamic properties of liquid and gaseous anhydrous ammonia are derived for values of reduced density up to 2.0 and reduced temperature up to 1.5. (DLC)

15179 (ORNL-tr–2729) FABRICATION OF HOLLOW CONICAL SHAPES BY CIRCUMFERENTIAL DEFORMATION. Brun, M.; Collette, G. Translated by R. G. Mansfield from Formage et Trait. Metaux; 27-32(Apr 1972). 19p. Dep. NTIS $3.00.

Macroscopic analysis of the circumferential deformation in conical shear spinning made it possible to demonstrate a mechanism of torsion, the magnitude of which is related to the instantaneous diameter of the piece being formed, to the feed, and to the difference of reduction in relation to the theoretical reduction. It appears to be practically independent of the nature of the metal, lubrication, and rate of rotation of the mandrel, and a law of variation for this is proposed. (DLC)

15180 (ORO-4311-2) QUANTITATIVE ANALYSIS OF SOLUTE SEGREGATION IN ALLOYS BY TRANSMISSION ELECTRON MICROSCOPY. Progress Report, January 1, 1972–August 31, 1972. Hren, J. J.; Hartley, C. S. (Florida Univ., Gainesville (USA). Engineering and Industrial Experiment Station). Aug 1972. Contract AT(40-1)-4311. 23p. Dep. NTIS $3.25.

Progress is reported on: adaptation of CSIRO image simulation, program, experimental studies of dislocations in Al and Al–0.84% Cu alloy, construction of displacement fields for image simulation, and image simulations. (DLC)

15181 (RFP-2090) ACOUSTIC EMISSION SOURCE LOCATION ON A NONSPHERICAL SURFACE. Sackschewsky, V. E.; Lott, L. A. (Dow Chemical U. S. A., Golden, Colo. Rocky Flats Div.). 1973. 17p. (CONF-730735-1). Dep. NTIS $3.00.

From summer acoustic emission working group meeting; Richland, Washington, USA (18 Jul 1973).

A procedure was developed and programmed to determine the location of an acoustic emission signal generated on a nonspherical surface, based on the arrival times of the signal at five transducers. The accuracy of this procedure was checked for the special case of a sphere and was found to be far in excess of the discrimination that can probably be achieved by the associated electronics in an actual system. (auth)

15182 (RFP-Trans-143) ANALOG MACHINE STUDY OF A PULSED ADAPTIVELY WORKING PNEUMATIC SERVO SYSTEM. Fredricson, B. (Foersvarets Forskningsanstalt, Stockholm (Sweden)). Translation of FOA-2-C-2176-54. 19p. Dep. NTIS $3.00.

An analog model of the servo system was described earlier (FOA-2-C-2157-54) and the speed response of different step-functions was studied at some various cases of power. An improvement of dynamic and static properties, achieved by filtering the feedback power signal and by feeding back the speed signal, is reported here. The measurements were made under more realistic conditions, e.g., dry friction was considered. Some measurements were made on a system with open regulation, which caused the control logic to be changed somewhat in comparison with the previous model. The advantage is the elimination of an amount of electropneumatic pressure generators. (auth)

15183 (RLO-2225-T-12-21) MOESSBAUER STUDIES AT HIGH PRESSURE. Annual Progress Report, March 1, 1973–February 18, 1974. Ingalls, R. L. (Washington Univ., Seattle (USA)). 1 Dec 1973. Contract AT(45-1)-2225. 5p. Dep. NTIS $3.00.

15184 (RLO-2227-T-12-39) LINEAR INSTRUMENT CALIBRATION WITH STATISTICAL APPLICATION. Larsen, I. L.; Wagner, J. J. (Oregon State Univ., Corvallis (USA). School of Oceanography). 1973. 17p. Dep. NTIS $3.00.

The establishment of a calibration line for an instrument is discussed. A mean and error term is established from repetitive measurements. The overall precision in establishing the calibration line may be poorer than that indicated by the sample replication error. Then, the statistical uncertainty in establishing the calibration line is considered. (MCW)

15185 (RLO-2227-T-12-40) FOOD HABITS OF DEEP-SEA MACROURID FISHES OFF THE OREGON COAST. Pearcy, W. G.; Ambler, J. W. (Oregon State Univ., Corvallis (USA). School of Oceanography). 1973. 26p. Dep. NTIS $3.50.

15186 (SC-DR-720267) PRELIMINARY DEVELOPMENT AND EVALUATION OF THE LIGHTNING ARRESTOR CONNECTOR. Traeger, R. K.; Olson, H. C.; Allen, L. J. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jul 1972. 57p. Dep. NTIS $5.00.

Lightning arrestor connector (LAC) development was initiated using the dielectric-stimulated arc concept based on the feasibility study results obtained by Cooper and Allen (SC-RR-71-0180). The initial development activity was directed toward the definition of LAC structural design requirements, manufacturing processes and techniques, and electrical and environmental responses of the LAC. Thirteen connectors, plus several models, were used to evaluate the rutile sleeve and anodized aluminum web gap designs. Both designs are manufacturable. Electrical breakdown (DC) occurred at about 1 kV. Maximum breakdown was 1.5 kV under lightning simulated currents of 20 and 200 kA. Function of a rutile sleeve design was not degraded by shock and vibration. No significant polarity, aging, or illumination effects were noted and decrease in insulation resistance due to excessive moisture absorption could be reversed by drying. (auth)

15187 (SLA-73-706) FLOW RATE EFFECTS DURING THE PYROLYSIS OF METHANE. Lieberman, M. L.; Noles, G. T. (Sandia Labs., Albuquerque, N. Mex. (USA)). Nov 1973. Contract AT(29-1)-789. 22p. Dep. NTIS $3.25.

15188 (SLA-73-734) DEVELOPMENT OF A COMPOUND SPRING. Becktell, M. J. (Sandia Labs., Albuquerque, N.Mex. (USA)). Dec 1973. Contract AT(29-1)-789. 33p. Dep. NTIS $3.75.

A method of designing a spring that has relatively low mass, a height-to-thickness ratio greater than 4:1 (the maximum allowable with Belleville washers), and three basic spring rates—increasing, constant, then increasing is described. (30 figures) (auth)

15189 (SLA-73-1014) ION MICROPROBE TECHNIQUES USED IN THE IDENTIFICATION OF AgCl AS A SURFACE CON-

TAMINANT ON HYBRID MICROCIRCUIT CAPACITORS. Guthrie, J. W. (Sandia Labs., Albuquerque, N.Mex. (USA)). Dec 1973. Contract AT(29-1)-789. 22p. Dep. NTIS $3.25.

An ion microprobe mass analyzer (IMMA) was used for the identification analysis of a micron-sized surface contaminant on hybrid microcircuit barium titanate capacitors with silver frit terminations. A 20-keV O_2^+ sputtering ion beam was used to obtain characteristic positive and negative-sputtered ion mass spectra, scanning ion micrographs, and depth profiles from clean and contaminated capacitors. The spectra from the contaminated capacitors contained significant peaks for $AgOH^+$, $BaCl^+$, Ag_2^+, Ag_2OH^+, Ag_2Cl^+, and Cl^- sputtered ion species. On the clean capacitors these species were detected only as low-intensity peaks or not at all. Silver chloride was identified as a major contaminant by comparing AgCl calibration mass spectra with the spectra obtained from the clean and contaminated capacitors. The calibration mass spectra were obtained by sputtering and analyzing AgCl deposited on Au, Mo, and Kovar substrates and AgCl deposited on the surface of a clean capacitor. (auth)

15190 (SLA-73-1019) CONTAMINATION OF HYBRID MICROCIRCUIT MIRRORS BY OXIDIZED TANTALUM. Kramer, D. K. (Sandia Labs., Albuquerque, N.Mex. (USA)). Jan 1974. Contract AT(29-1)-789. 11p. Dep. NTIS $3.00.

Deposition of CrAu metallization on alumina substrates has, on occasion, resulted in a gold film which is noticeably darker than the normal bright gold. Auger electron spectroscopy identified the surface contamination as tantalum oxide. TaO_x is evaporated from the Au deposition boat after the Au charge has been depleted. Maintaining a high mole fraction of Au in the deposition boat should eliminate the problem. (auth)

15191 (SLA-73-1021) THERMAL ANALYSIS FOR INSERTION OF ANTENNA WINDOW IN THE NOSETIP OF AN AIR-TO-GROUND MISSILE. Smith, J. H.; McCulloch, W. H. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jan 1974. Contract AT(29-1)-789. 17p. Dep. NTIS $3.00.

Pyrolysis and subsequent formation of a carbonaceous char layer on the phenolic refrasil nosetip of an air-to-ground missile occur routinely during certain required trajectories. In order to adequately flight-test this missile, a nosetip telemetry antenna must be added. However, the conductive char layer is highly attenuating to the electromagnetic radiation. The analyses entailed in the nosetip re-design for insertion of a noncharring antenna window while preserving the original body contour are discussed. Various portions of the analyses deal with convective heating from the boundary layer, conduction into the nosetip, radiation to space, and decomposition of the phenolic refrasil. (auth)

15192 (SLA-73-5637) MODULARIZATION OF ELECTRICAL CONNECTORS. MacAvoy, D. W.; Hoffman, C. K. (Bendix Corp., Sidney, N.Y. (USA). Electrical Components Div.; Sandia Labs., Albuquerque, N.Mex. (USA)). 1973. 19p. (CONF-731035-1). Dep. NTIS $3.00.

From Cherry Hill connector symposium; Cherry Hill, New Jersey, USA (Oct 1973).

A modular connector and ancillary components were designed to meet demanding electrical and mechanical requirements for use in detecting and analyzing seismic and acoustic variations in the environment in which they were placed. The modular connector provides the make-and-break connection for an electric circuit and the housing and wiring for an electronic circuit mounted on a printed circuit. The termination connectors have fixed-power contacts with solder cups and removable coaxial contacts with coaxial wire leads. (12 figures) (MCW)

15193 (SLA-73-5764) STRAIN MEASUREMENT IN PARACHUTE WEBBING WITH ELASTOMERIC STRAIN GAGES. McVey, D. F. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1973. 27p. (CONF-730928-1). Dep. NTIS $3.50.

From conference on stresses and strains in textile structures; Manchester, UK (12 Sep 1973).

Results show that the elastomeric strain gage can be used on parachute webbings to obtain static and dynamic strain data up to at least 25% and possibly as high as 30 to 35% elongation. To obtain best accuracy, calibration curves should be developed for each material on which the gage is to be used. Errors in strain reading caused by webbing curvature can be reduced to less than 0.5% if the ratio of the gage length to the radius of the curve is less than 0.15. Initial tests indicate that the gages can withstand the environment encountered during parachute packing and deployment. (17 figures) (auth)

15194 (SLA-73-5951) OPTIMAL OBSERVERS FOR TIME VARYING LINEAR SYSTEMS. Watts, A. C.; McDaniel, W. L. Jr. (Sandia Labs., Albuquerque, N. Mex. (USA); Mississippi State Univ., State College (USA). Dept. of Electrical Engineering). [nd]. 6p. (CONF-731203-1). Dep. NTIS $3.00.

From conference on decision and control; San Diego, California, USA (5 Dec 1973).

A method is presented for generating the optimal control of a linear system from measurements of the system input and output. The systems considered are n-th order, time invariant or time varying forced linear systems that are restricted to be bounded and uniformly completely state reconstructible. The control is generated from an estimate of the state vector that is obtained from an observer. The observer dynamics are derived from an optimal estimation formulation that is closely related to the concept of observability. Asymptotic stability of the observer is demonstrated and the effects of initial errors are considered. The result is a practical method of estimating the state of a linear system from noiseless measurements of the input and output. Additionally, theoretical results are obtained concerning the existence of observers for time-varying linear systems. (auth)

15195 (SLA-73-6001) EFFECT OF BERYLLIUM ADDITIONS ON THE MICROSTRUCTURE AND TYPE OF FAILURE OF Al–Mg ALLOYS. Afanas'ev, V. K.; Dmitrievtseva, E. A. Translated by P. Newman from Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; 15: No. 5, 121-123(1972). 8p. Dep. NTIS $3.00.

The effect of small quantities of beryllium on the microstructure, type of failure, microhardness, tensile strength, stability, and plasticity of Al–Mg alloys containing from 1 to 13% Mg is studied. Metallographic studies were made of samples in the cast, tempered, annealed, and aged states. Microsections were examined in light and dark fields with magnification of 110 and 260 times. (MCW)

15196 (UCID-16383) HIGH-RESOLUTION OPTICAL IMAGING ON THERMOPLASTIC FILM. Chambers, E. S.; Hsieh, H. J.; Lee, E. L.; Boogaard, J. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 16 Nov 1973. Contract W-7405-Eng-48. 18p. Dep. NTIS $3.00.

Experimental details of a novel method for recording optical images is presented. In this method, a photoconductive layer arranges electric charges according to the optical image projected onto it. The differential electric fields thus produced, squeeze a thermoplastic layer into ridges that constitute the final image. The interference of two laser beams (0.63 μm) that formed an optical image of 1000 cycles/mm was clearly and accurately recorded. The spatial frequency response differs from the conventional photographic method and is well suited for holograms. The image can be erased and the medium reused many times. The thermoplastic layer alone can be "written on" by charges applied by touching with a thin wire. (auth)

15197 (UCID-16400) RESPONSE OF A RECESSED PRESSURE TRANSDUCER WITH A MILLISECOND PRESSURE STEP INPUT. Shay, W. M.; Kuhlman, J. (Californai Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Nov 1973. Contract W-7405-eng-48. 13p. Dep. NTIS $3.00.

All too often, dynamic pressure measurements are made with the sensitive part of the transducer, the diaphragm, recessed and away from the pressure source. If the transducer has been recessed far enough from the pressure source, an invalid pressure measurement will result. To explore the effect of recessing, the Reynolds pneumatic accelerator was used to produce a pressure step with a rise time from 0.5 to 2 ms. Results are presented. (auth)

15198 (UCRL-51094) NEW CONCEPTUAL FRAMEWORK FOR STUDYING DYNAMIC LIVING PROCESSES: PHYSICAL THEORIES, COMPUTATIONS, AND EXPERIMENTS. Yee, D. M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 27 Jul 1973. Contract W-7405-eng-48. 108p. Dep. NTIS $5.45.

Thesis.

Ion selectivity, the ability of a biological cell membrane to selectively transport one species of ion to the exclusion of all others, is absolutely necessary to the viability of the cell. Because it is so important to cell function and because it has not been clearly identified as a physical phenomenon, ion selectivity was chosen as the subject of the present research. The phenomenon of ion selectivity is treated here as an electrochemical process. (LMT)

15199 (UCRL-74751) ROOM-TEMPERATURE-CURABLE EPOXY FOR ADVANCED FIBER COMPOSITES. Chiao, T. T.; Moore, R. L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Sep 1973. 16p. (CONF-740204-1). Dep. NTIS $3.00.

From 29th annual technical and management conference; Washington, District of Columbia, USA (5 Feb 1974).

A room-temperature-curable epoxy system, a pure bis-phenol A resin cured with a polyether triamine, was investigated for filament winding of advanced fiber composites. This system was used in two production operations and its handling characteristics

are satisfactory. The system can be cured either at room temperature or at moderate temperatures (up to 70°C) to give well-balanced properties. Neither delamination nor fiber microbuckling of advanced composites parts using this resin system was experienced. The typical properties are: in tension, 73 MPa (10,800 psi) failure stress, 3240 MPa (470 ksi) modulus, and 4.6% failure strain; in compression, 88 MPa (12,700 psi) yield stress, 3490 MPa (505 ksi) modulus, and 3.7% yield strain; and in shear, 62 MPa (8930 psi) failure stress, and 12.7 MPa (184 ksi) modulus. (auth)

15200 (UCRL-75181) CELL CYCLE IN MALIGNANT AND NORMAL TISSUES. Mendelsohn, M. L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 8 Nov 1973. 26p. (CONF-731005-3). Dep. NTIS $3.50.

From 13th Hanford biology symposium on the cell cycle in malignancy and immunity; Richland, Washington, USA (1 Oct 1973).

Methods for studying cellular proliferation in tumors and normal tissues are reviewed, with emphasis on frequency of labeled mitoses, growth fraction, cell loss and the turnover of nonproliferating cells. Attention is also paid to methods based on measurement of DNA content of individual cells, including flow microfluorimetry, cytophotometry, and the combination of cytophotometry and autoradiography. Finally, a survey is given of selected cell cycle measurements from 50 examples of normal tissues, tumors, ascites cell tumors and tissue cultures. (15 figures, 40 references) (auth)

15201 (Y-1880) PROPERTIES OF CARBONS DERIVED FROM ACENAPHTHYLENE AND CINNAMLIDENEINDENE. Horne, O. J.; Smith, W. E.; Napier, B. (Oak Ridge Y-12 Plant, Tenn. (USA)). 7 Dec 1973. Contract W-7405-eng-26. 47p. Dep. NTIS $4.00.

The effect of temperature and various additives on the properties of acenaphthylene (ACN) and cinnamylideneindene (CAI), and carbons derived from ACN and CAI, were studied. In thermal studies, a CAI polymer was found to be relatively stable for extended periods at 250°C, while significant property changes were noted for an ACN polymer under the same conditions. By blending various additives with ACN and CAI prior to pyrolysis, a wide variety of carbon properties were obtained, thus affording avenues to control these properties by modifying the precursors. (auth)

15202 NEW DEVELOPMENTS IN GRINDING. Proceedings of the International Grinding Conference, Pittsburgh, Pennsylvania, April 18–20, 1972. Shaw, M. C. (ed.). Pittsburgh; Carnegie–Mellon University Press (1972). 972p. (CONF-720483-). $25.00.

The program was divided into three parts, namely: (1) abrasive grain considerations; (2) grinding performance; and (3) diamond and miscellaneous grinding operations. A total of 48 papers were presented, three being keynote papers for each part (above) that were designed to introduce the papers that followed. (LMT)

15203 KERR-CELL STUDIES OF EXPLODING WIRES IN VACUUM. Nyberg, S. O.; Handel, S. K.; Stenerhag, B. (Uppsala Univ.). pp 507-510 of Transactions of the 10th International Conference on Ultrahigh-speed Cinematography. Paris; Association Nationale de la Recherche Technique (1973).

From tenth international conference on ultrahigh-speed cinematography; Nice, France (25 Sep 1972).

Wires made of high-boiling-point materials were electrically exploded in an evacuated vessel of coaxial design. The initiation of the shunting gas discharge and the vaporization of the wire were studied by means of a single-frame, Kerr-cell shutter camera. It was found that the influence of the radial electric field on the shunting discharge was negligible and that the vaporization of long tungsten wires is very nonuniform. A model to explain the latter is suggested. (auth)

15204 EXPLODING WIRES AS A SOURCE OF FLASH X RAYS. Stenerhad, B.; Handel, S. K.; Nyberg, S. O. (Uppsala Univ.). pp 362-366 of Transactions of the 10th International Conference on Ultrahigh-speed Cinematography. Paris; Association Nationale de la Recherche Technique (1973).

From tenth international conference on ultrahigh-speed cinematography; Nice, France (25 Sep 1972).

The exploding-wire technique and equipment used for x-ray flash generation are described. A tungsten wire, electrically exploded in vacuum, gives rise to a single, reproducible x-ray pulse of about 20-nsec duration. The basic processes involved in x-ray generation are discussed. The exploding-wire technique is shown to be capable of producing two or more x-ray pulses of high repetition rate by using only one capacitor. (IAA)

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Fourteen interested countries in Asia, southeast Europe, and Latin America have just been surveyed by the International Atomic Energy Agency (IAEA) to determine the size and timing of the installations of nuclear power plants that for economic reasons could justifiably be built during 1980—1989. The survey was undertaken by IAEA with the financial help of the International Bank for Reconstruction and Development, the Inter-American Development Bank, and several industrialized IAEA Member States.

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